Chemical Engineering

OCTOBER 1954

HOW TO SOLVE
Engineering Problems
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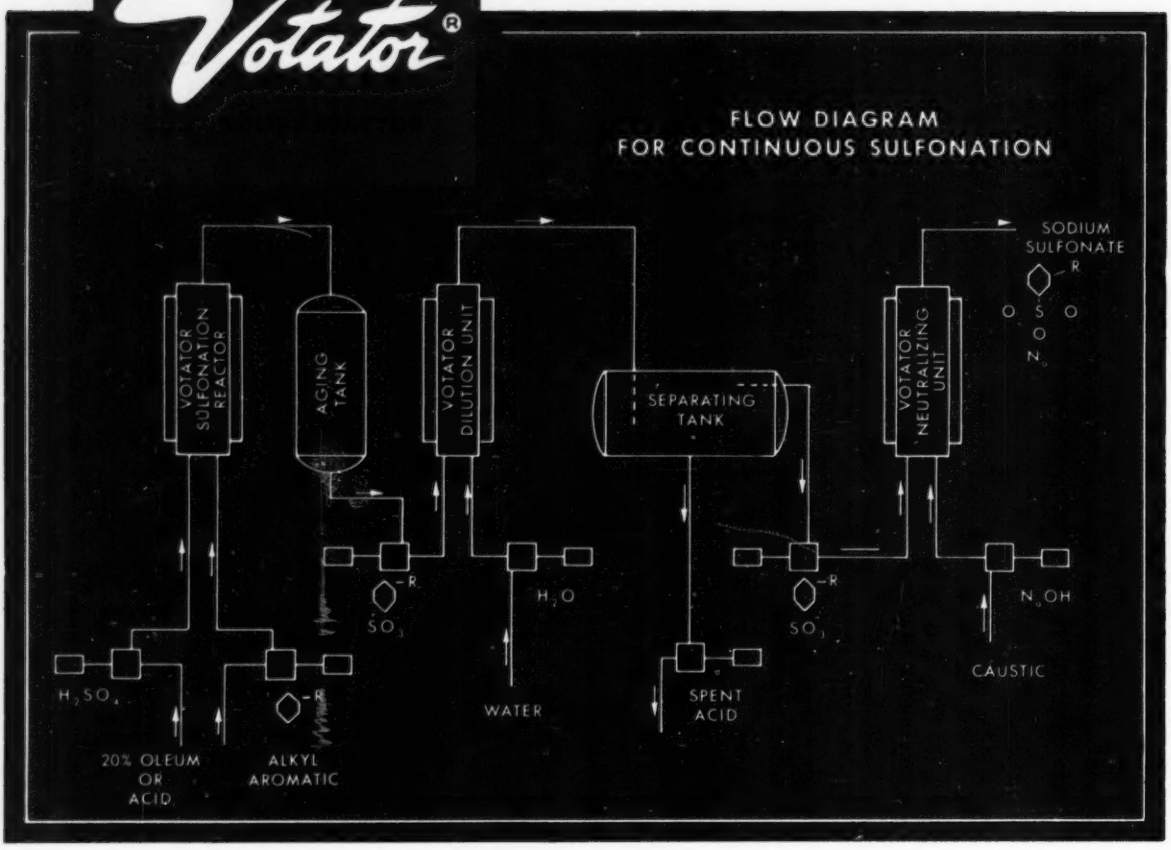


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Controls heat of reaction for processing viscous and heat sensitive materials

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GUIDED TOUR

JOHN R. CALLAHAM, EDITOR

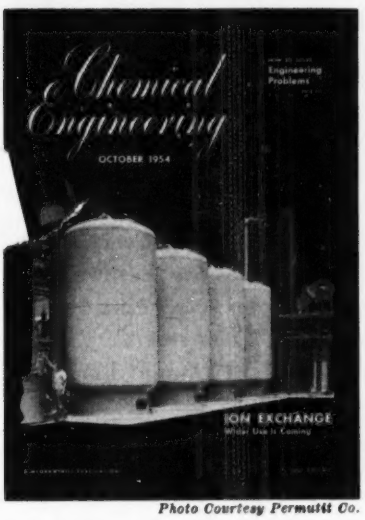


Photo Courtesy Permutit Co.

Within a Few Weeks . . .

Last month we said you'd get your copy of CE's 1st Annual Inventory Issue within a few weeks. What happened?

This has been our first experience with this special Inventory Issue, an innovation in the entire chemical publishing field. So naturally we were in for a few surprises. The whole job, far bigger than we first thought, now runs well over 200 editorial pages!

Format, too, has required a lot of attention to details. Since all material in this Inventory Issue is of permanent reference value (as its name suggests) we went out of our way to develop a new format—a "checklist" type of format—so that the entire issue would be easy to scan, easy to use, a convenient reference.

We're sorry about the month's delay. But it has allowed us to do a more comprehensive and more useful job. In that sense, it's all to the good.

You'll receive your special Inventory Issue within a few weeks—about mid-October. That's a promise!—JRC

. . . This month: Special report on ion exchange as a new unit operation.

In a comprehensive, 20-page roundup, SRI's Hiester and Phillips review present status of this up-and-coming unit operation, bring you up to date on latest developments, indicate what future trends to keep an eye on. They cover exchange materials as well as the equipment, design and process uses of batch, fixed-bed, continuous and electromembrane exchange techniques. (p. 161)

Save time, money, with computers . . .

. . . says Dow's Ascher Opler, a pioneer in the field. Here he packs 12 pages with down-to-earth information on what computers can do, how they operate, how to pick them, training personnel, costs and obsolescence. (p. 197)

Need help in finding cost data?

Then this index is right down your alley! Jim Weaver, in a pioneering and top-notch job, lists 351 literature references and 402

Please turn page

GUIDED TOUR

subject items. A valuable tool that CE will up-date each year. (p. 185)

Why coordinate materials handling?

Because it can snarl up your entire operation from receiving platform to process to shipping. Here's hard-headed advice on why you must coordinate early in the game, how you should go about it. (p. 194)

Capture kiln heat—and save money.

You can now put to good use that wasted heat from your rotary kiln. You'll save labor and fuel costs, increase throughput. CE makes a rundown of recent developments in the U. S. and abroad. (p. 181)

Heard the latest in raw materials?

How styrene-butadiene paints are driving hard to capture the lush house exterior market? Or scores of other developments that could have an impact on your operations? Product News covers the field. (p. 142)

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Chemical Engineering

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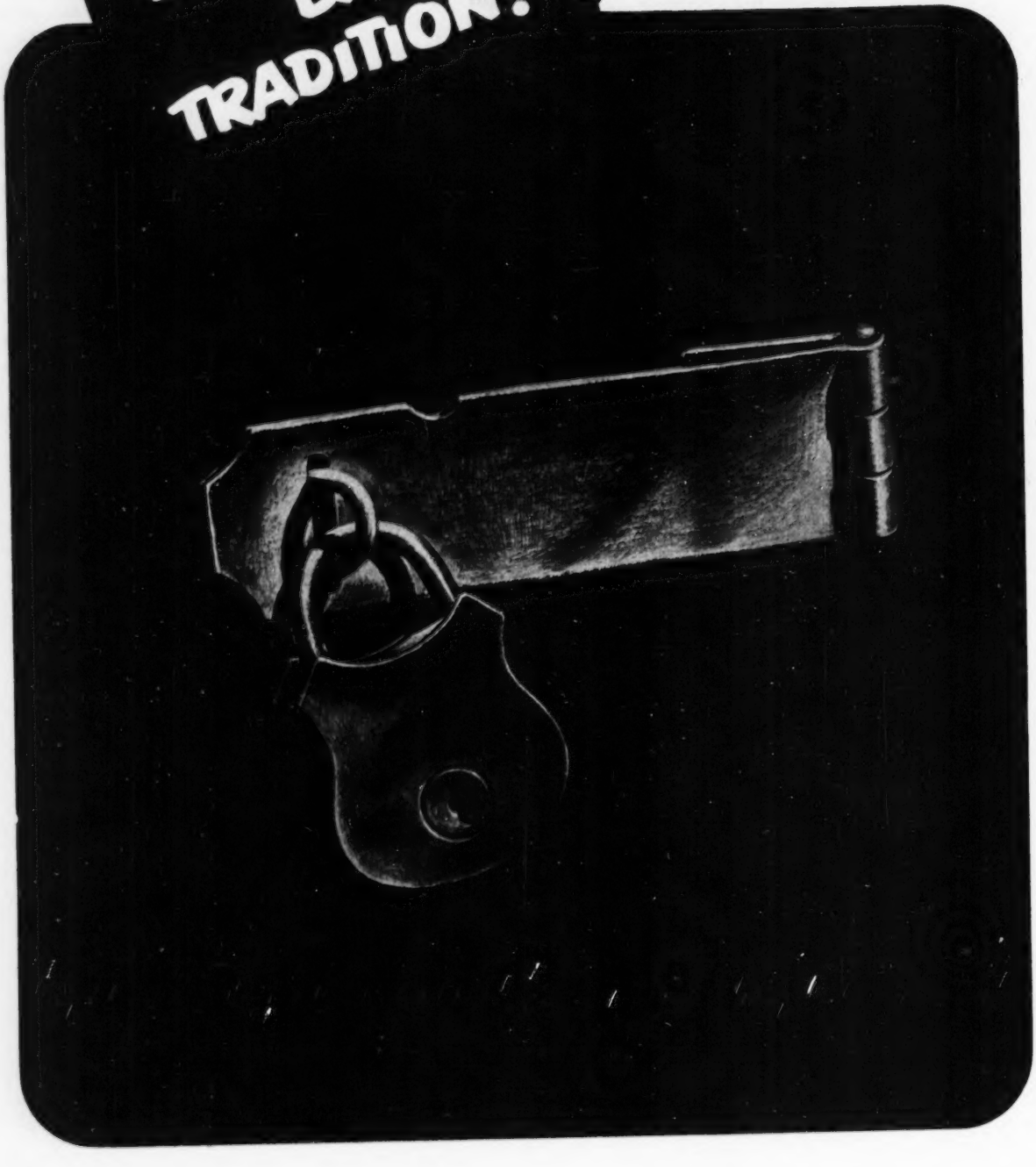
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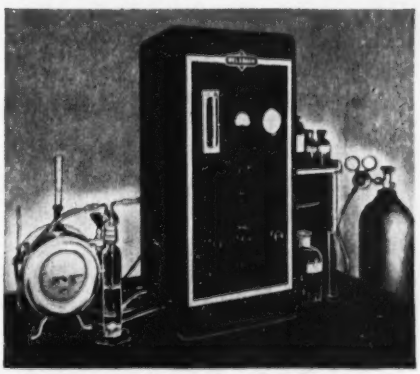
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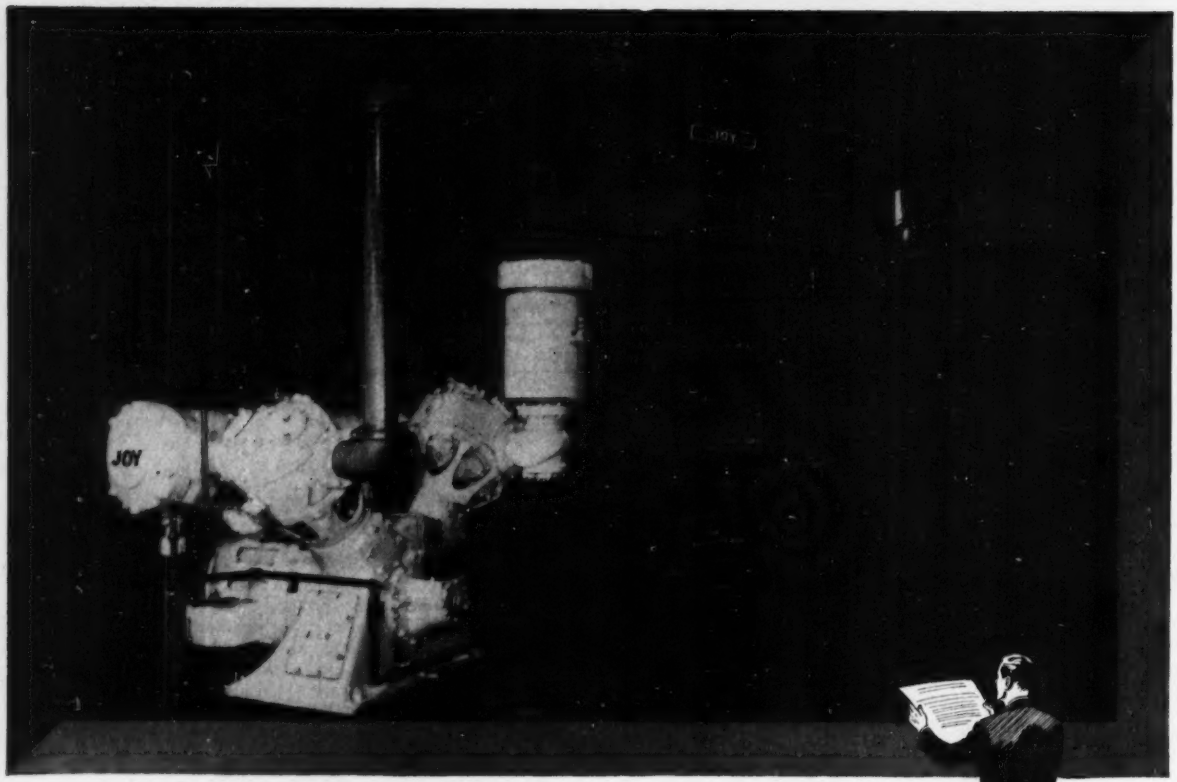


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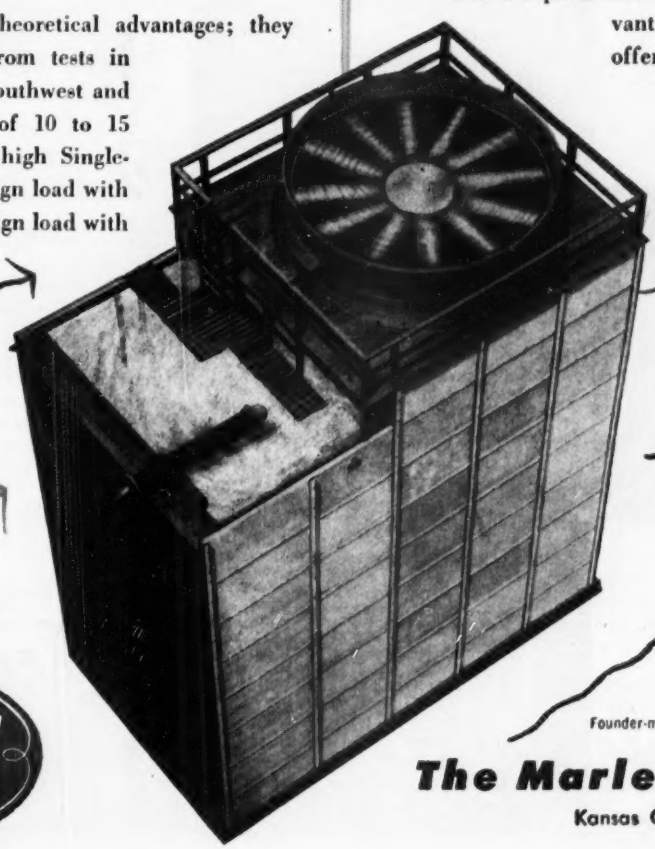
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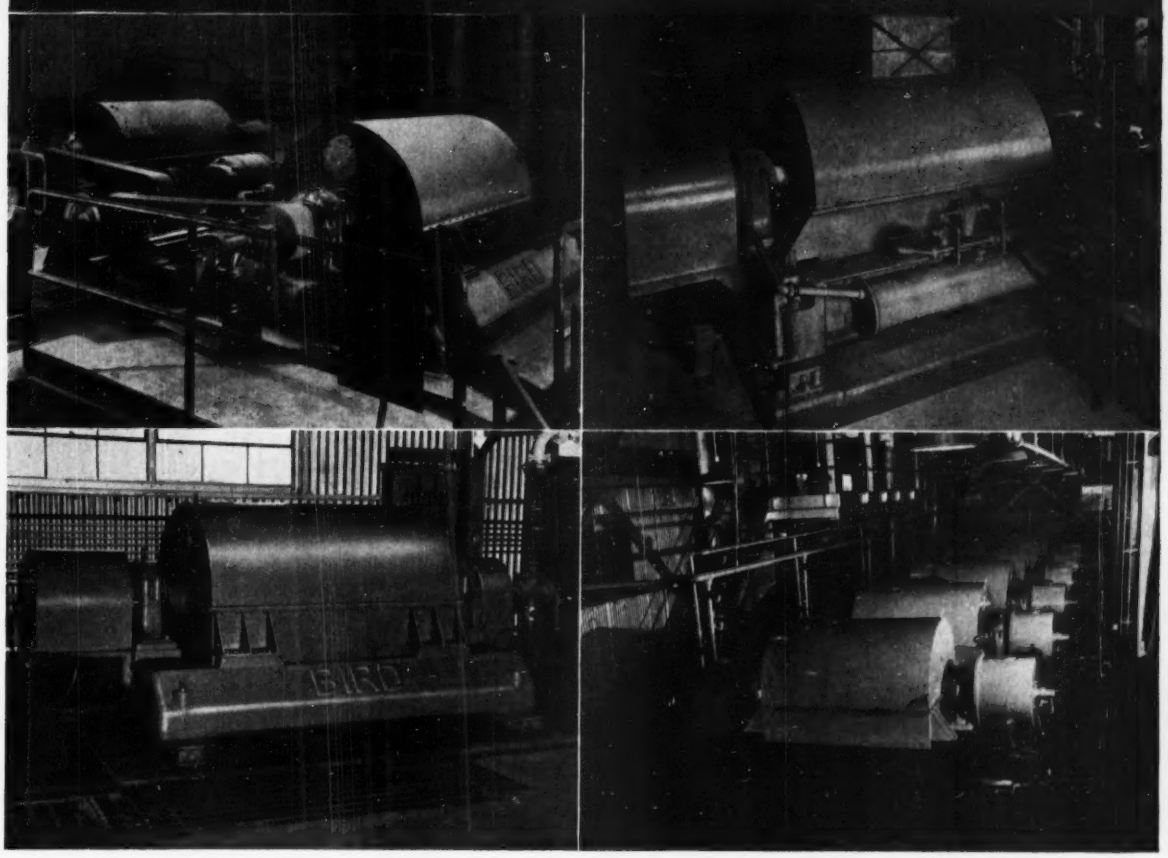
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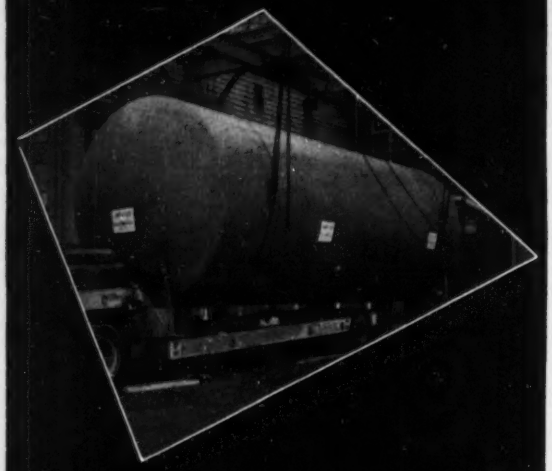
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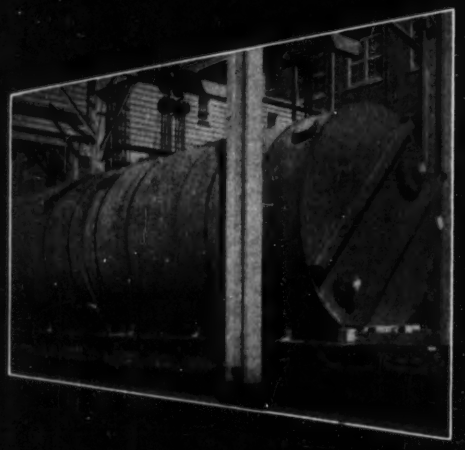
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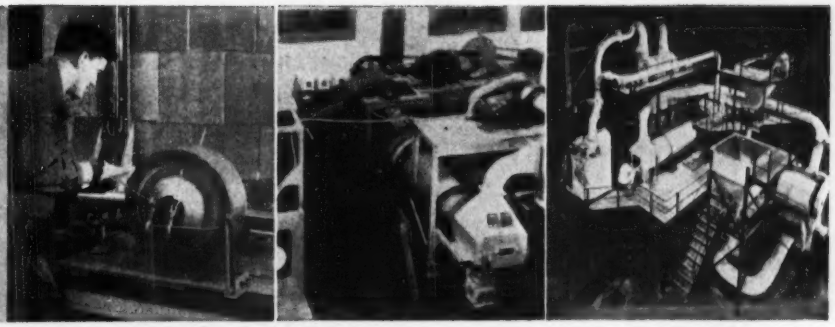
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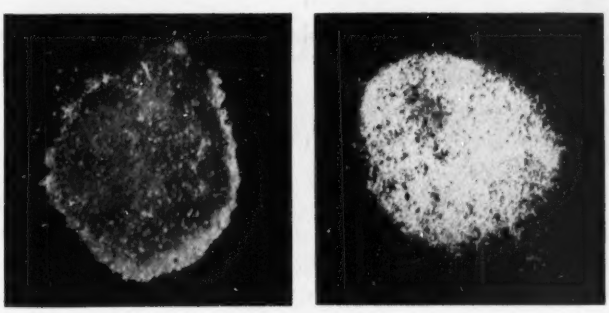
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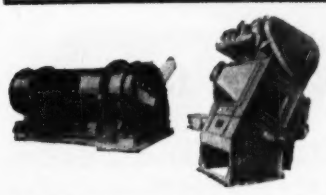
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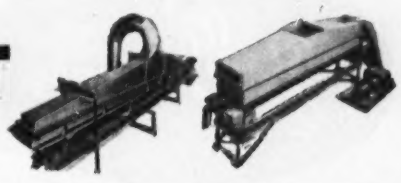
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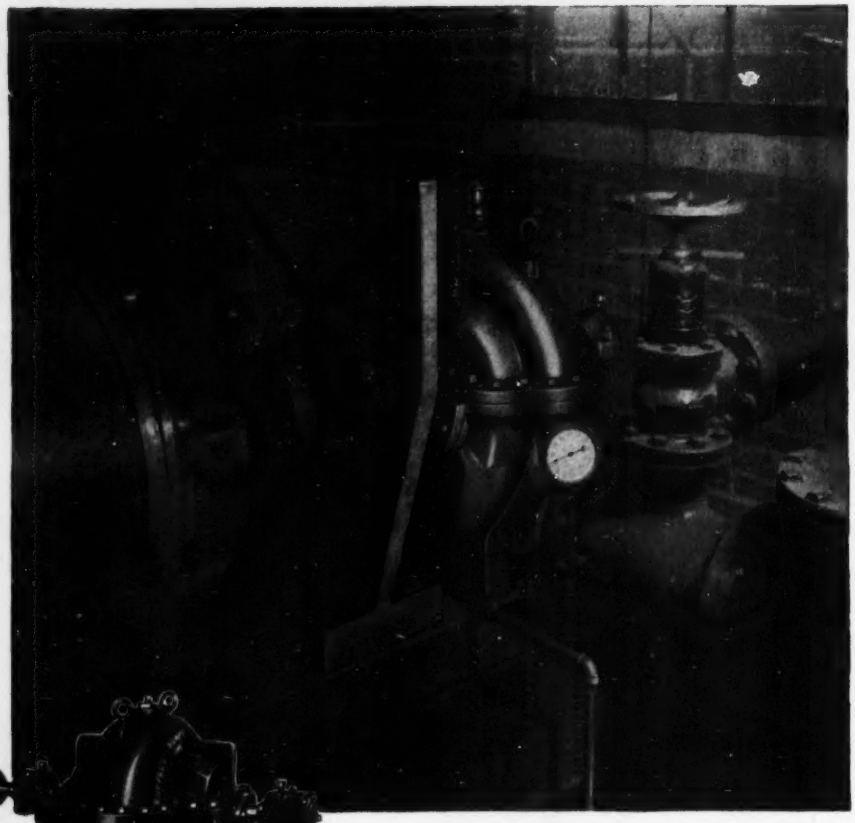
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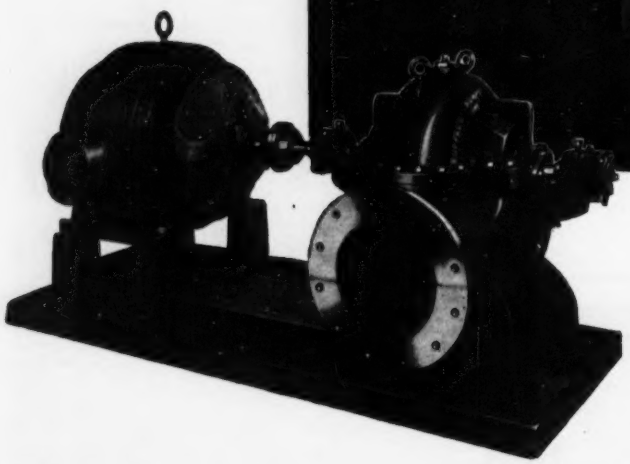


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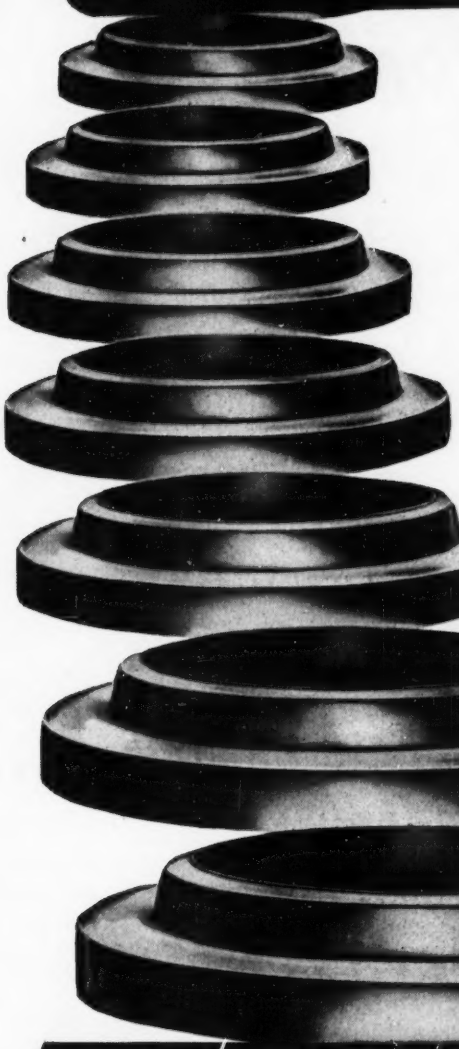
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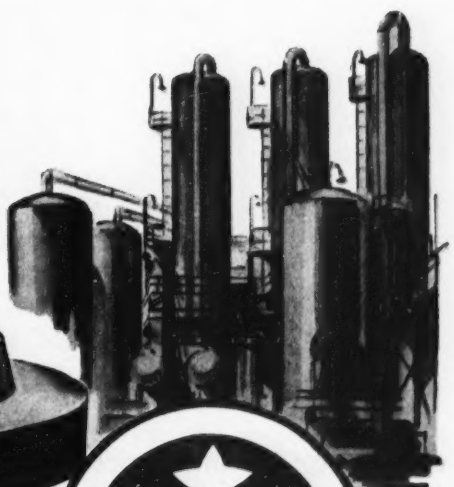
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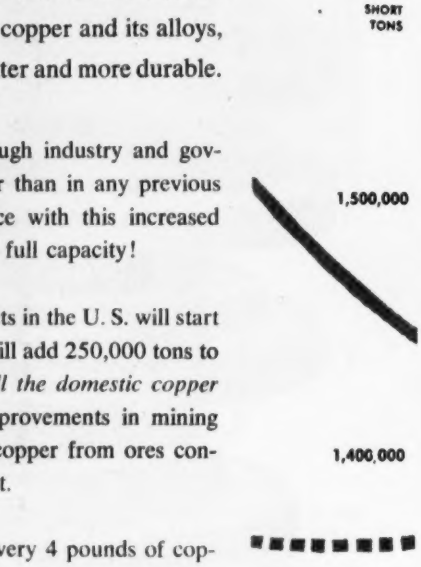
today and tomorrow

The assurance that copper is in abundant supply and *can be used without restrictions* is the "go ahead" for industry. You can now rate PERFORMANCE over AVAILABILITY when choosing materials. By using copper and its alloys, brass and bronze, your product is easier to fabricate, better and more durable.

We can get more copper than we now have. Although industry and government have been consuming more copper than in any previous peacetime period, production has kept pace with this increased demand. And producers are not working at full capacity!

More copper keeps on coming. Eleven major new projects in the U. S. will start producing in the next 3 years. These mines will add 250,000 tons to our annual production—more than *¼ of all the domestic copper mined during 1953*. In addition, recent improvements in mining techniques now make it possible to obtain copper from ores considered commercially unworkable in the past.

Copper is virtually indestructible. At least 3 out of every 4 pounds of copper used in today's products, when scrapped, can be re-used in the future. Every day we are adding to our "copper capital". The more copper we use . . . the more we have!



Copper or its alloys provide these advantages . . .



Best conductor of electricity commercially available.



Does not rust . . . high corrosion resistance.



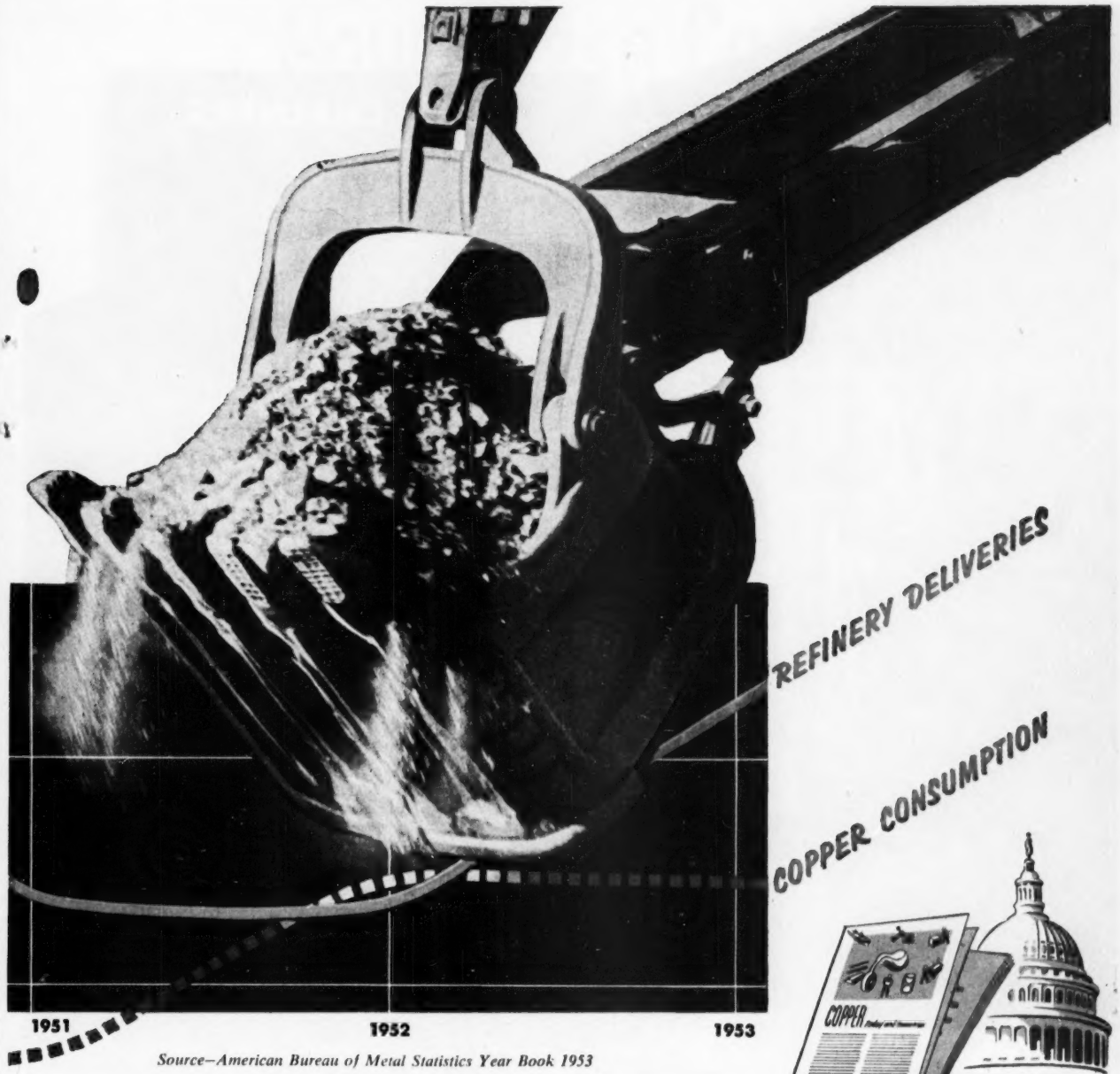
Best heat transfer agent of all commercial metals.



Easy to machine, form, draw, stamp, polish, plate, etc.



Welds readily . . . excellent for soldering and brazing.



Source—American Bureau of Metal Statistics Year Book 1953

Copper has a new ability to serve you. Many of your problems are being solved in the laboratories of the copper and brass industry. Whether it's a new alloy, a different temper or a special property . . . copper can help you develop new ideas. Copper can bring old methods up to date. Call a supplier of copper and brass and convert your thoughts to action!

COPPER & BRASS
Research Association

✻ ***"Copper . . . is fortunately available in ample supply to meet any foreseeable demand"***

Foreword, U. S. Dept. of Commerce
B.D.S.A. Copper Quarterly, August 1954

For information about U. S. copper supplies including free copies of this Government report and the new booklet, "Copper . . . Today and Tomorrow", send attached coupon to:

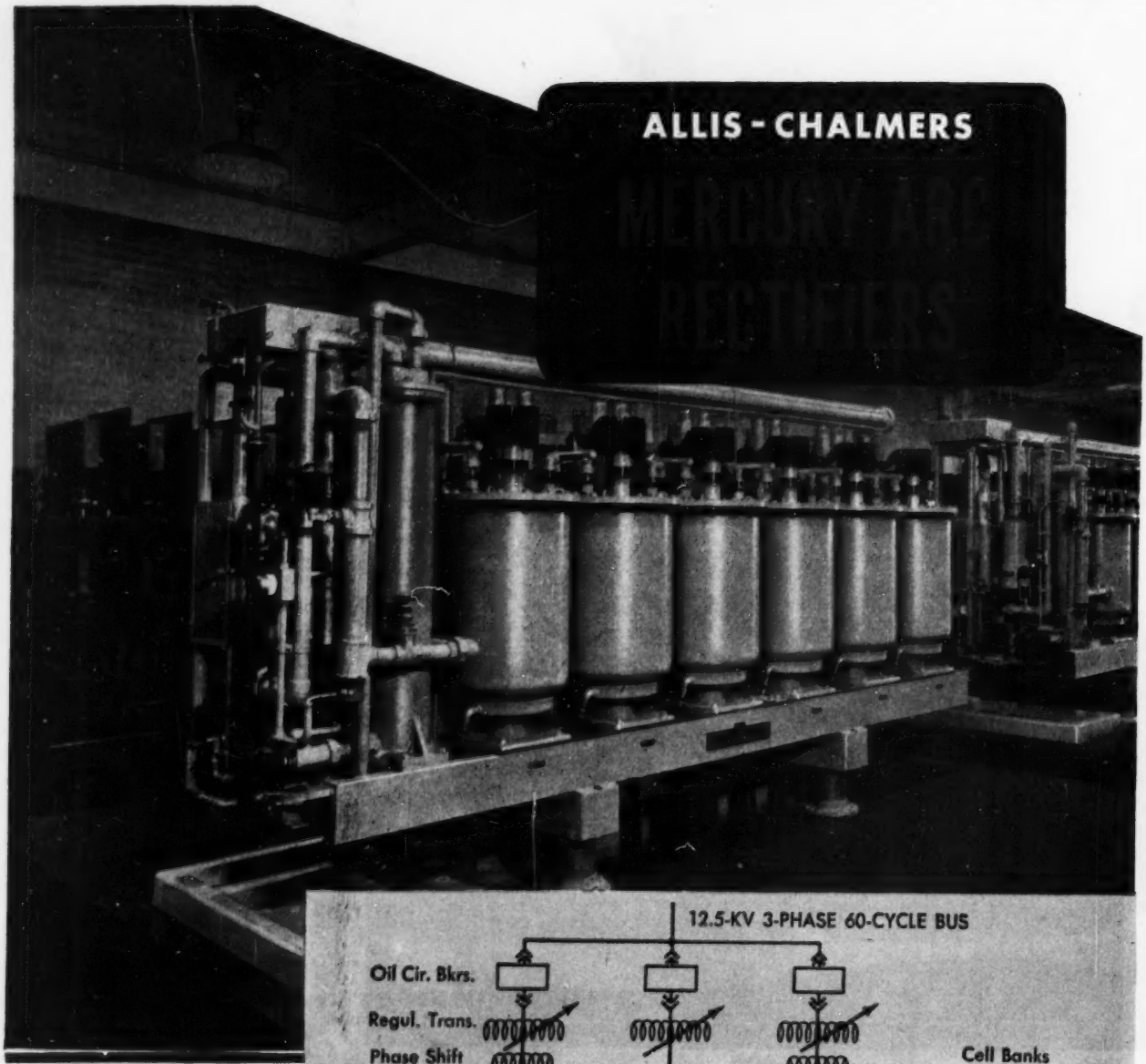
Copper & Brass Research Assn., Dpt. Z
420 Lexington Ave., New York 17, N. Y.

NAME .....

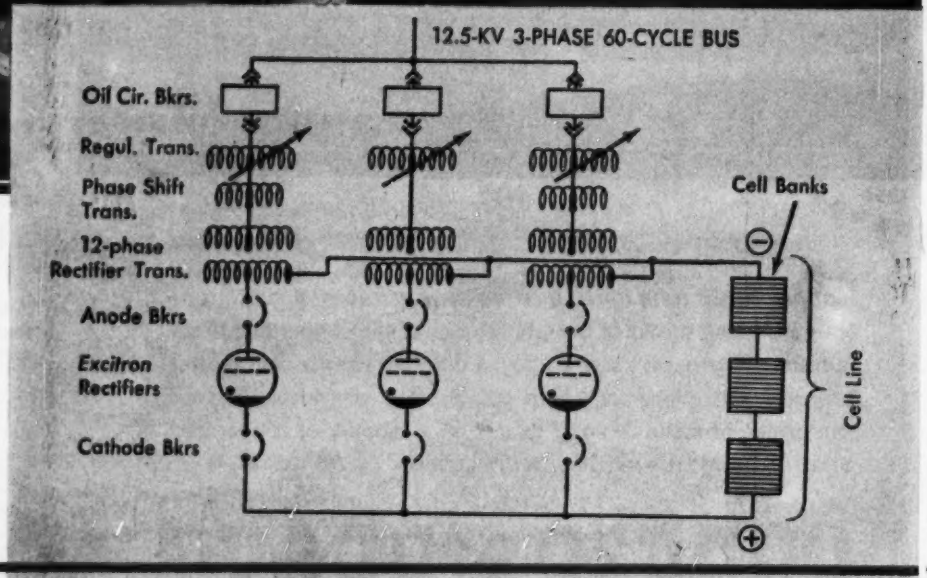
COMPANY .....

ADDRESS .....

CITY ..... STATE .....

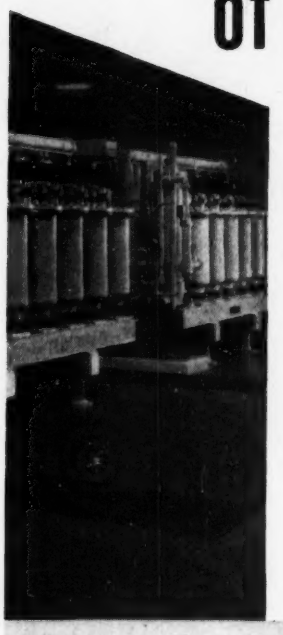


RECTIFIER ROOM SHOWS the three rectifiers used in this 10,000-kw, 600-volt installation. Each rectifier has 12 tubes, permitting 36-phase plant operation. Because complete loss of power supply, even for a short time, may seriously disturb the electrolytic process, provision has been made to transfer to plant supply in case of outside power failure.



SCHEMATIC DIAGRAM SHOWS simplified system layout, which eliminates unnecessary components, reduces cost. Phase control provides for gradual drop of load. No breakers operate during cell bank switching.

How Phase Control of Rectifiers Cuts Time & Cost of Automatic Cell Bank Switching



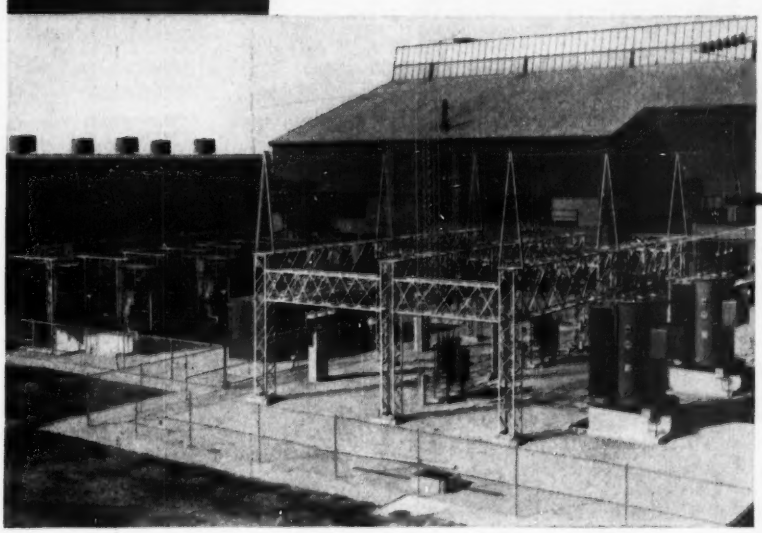
AT A SOUTHWESTERN ELECTROLYTIC ZINC PLANT, cell bank switching is made fast and simple through use of phase control on mercury arc rectifiers. Electrodes in the zinc cells must be stripped daily.

The extreme high accuracy of firing with Allis-Chalmers excitron rectifiers permits the necessary switching to be done with phase control. By operating a phase control switch in the cell room, the cell lines can be unloaded. Then, a bank of cells is isolated for stripping, and a spare cell bank, previously stripped, is substituted. Normal load operation is resumed by operating the phase control switch. No power breakers need be opened. The complete operation takes but a few minutes.

Three features of Allis-Chalmers mercury arc rectifiers assure successful operation with phase control. Continuous excitation — pilot arcs always present — eliminates the need for reignition every cycle, thus makes rectifiers less sensitive to supply voltage dips. The design of grid control system provides highly accurate control of rectifier firing. Finally, cooling of rectifiers by means of internal seamless steel coils assures proper distribution of mercury vapor for best operation at all loads.

These features in addition to advanced application engineering may help cut costs on your next rectifier installation. Get complete information from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

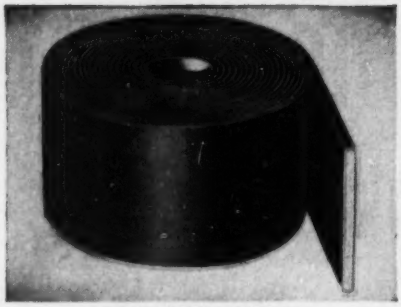
A-4423



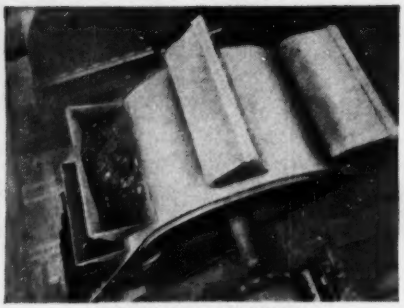
EXCEPTIONALLY FLEXIBLE AUTOMATIC LOAD CONTROL of this installation is provided by a combination of step-type regulating transformers with phase control, which assures close cell current regulation with maximum power factor.

ALLIS-CHALMERS

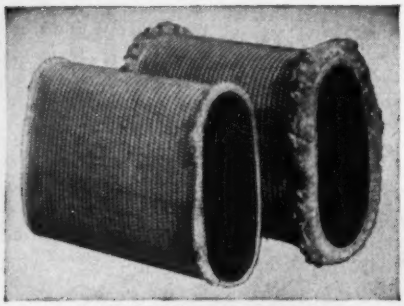
Engineered to Give



CONVEYOR BELTING



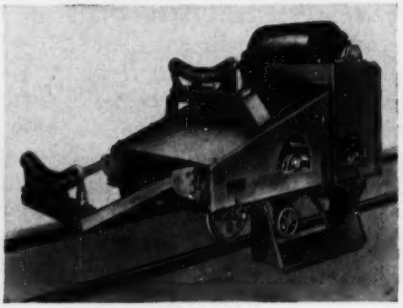
ELEVATOR BELTING



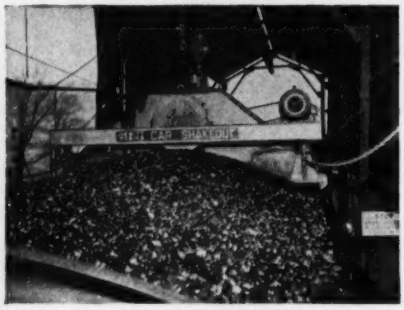
MONARCH® FIRE HOSE



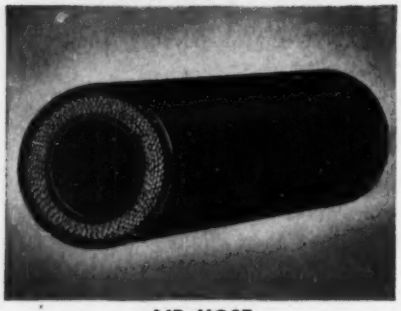
ENGINEERED-CONVEYORS



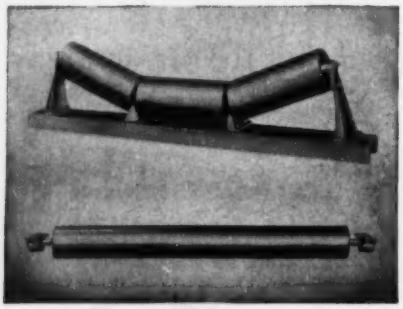
TRIPPERS



CAR SHAKEOUTS



AIR HOSE



IDLERS

Bulk Materials Handling Systems and Equipment for Chemical Processing

Whether your problem is the handling of solid or liquid materials . . . dry classification . . . feeding or blending of solids in bulk . . . Hewitt-Robins can provide you with the right answer. Because Hewitt-Robins is the only firm in its field which designs, engineers and constructs specialized bulk materials handling and processing equipment to meet all the requirements on every job.

Hewitt-Robins Engineering Division has engineers whose past experience qualifies them to solve almost any bulk materials handling and processing problem which might arise.

Hewitt-Robins Machinery Division manufactures a complete line of specialized machinery for conveying, screening, sizing, elevating, distributing, blending and storing loose bulk materials of every description.

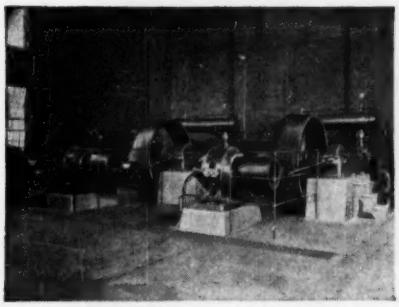
Hewitt-Robins Rubber Division produces a wide range of rubber conveyor belts, transmission belts, industrial rubber hoses and molded rubber products.

By dealing with Hewitt-Robins you'll save time and trouble . . . our combined divisions will furnish you with better integrated bulk materials handling systems and better designed and constructed processing equipment to solve every chemical processing problem.

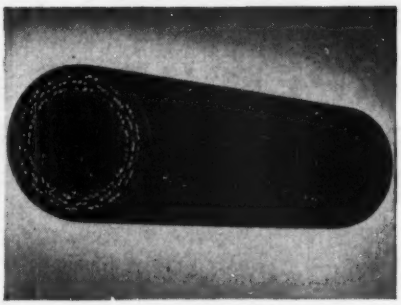
HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

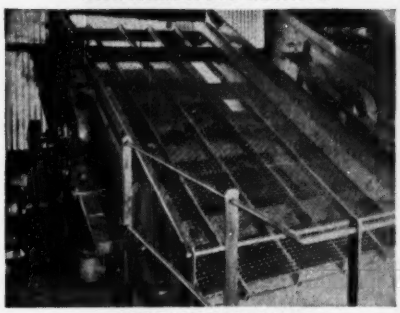
You Better Service



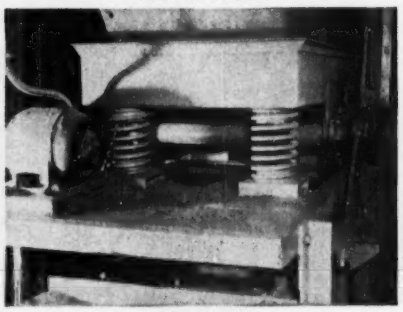
TRANSMISSION BELTING



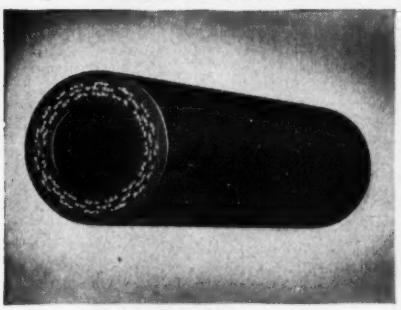
STEAM HOSE



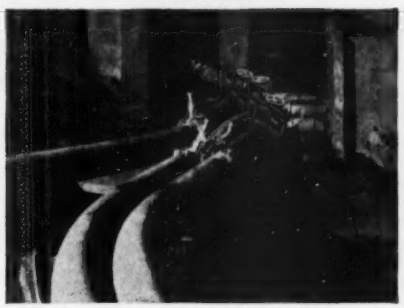
GYREX® SCREENS



FEEDERS



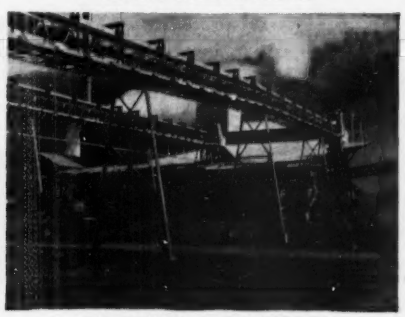
WATER HOSE



PINCH VALVE HOSE



STACKERS



SECTIONAL CONVEYORS

Here is a partial list of

HEWITT-ROBINS PRODUCTS

that will help you cut handling costs and increase operating efficiency.

MACHINERY

Belt Conveyors
Belt & Bucket Elevators
Car Shakeouts
Conveyor Idlers
Dewaterizers
Mechanical Feeders
Foundry Shakeouts
Mine Conveyors
Reclaiming Systems
Screen Cloth
Stackers & Trippers
Vibrating Conveyors & Screens

INDUSTRIAL RUBBER PRODUCTS

BELTING:

Conveyor
Elevator
Transmission

HOSE:

Acid
Air & Air Drill
Barge Loading
Dust Suction
Fire
Fuel Oil & Gasoline
Gasoline Pump
Mud Pump Suction
Oil Suction & Discharge
Propane-Butane
Road Builders'
Rotary Drilling
Sand Blast
Sand Suction
Sea Loading
Servall®, All-Service
Steam
Tank Car & Tank Truck
Vacuum & Air Brake
Water & Water Suction
Welding, Twin-Weld®

•

For information and service on industrial rubber products, contact your Hewitt-Robins Industrial Supply Distributor. Through his complete stock of Hewitt-Robins Rubber products, and his familiarity with local field conditions, he can fill your supply needs promptly and correctly. See Classified Phone Book for the Hewitt-Robins Industrial Supply Distributor serving your area.

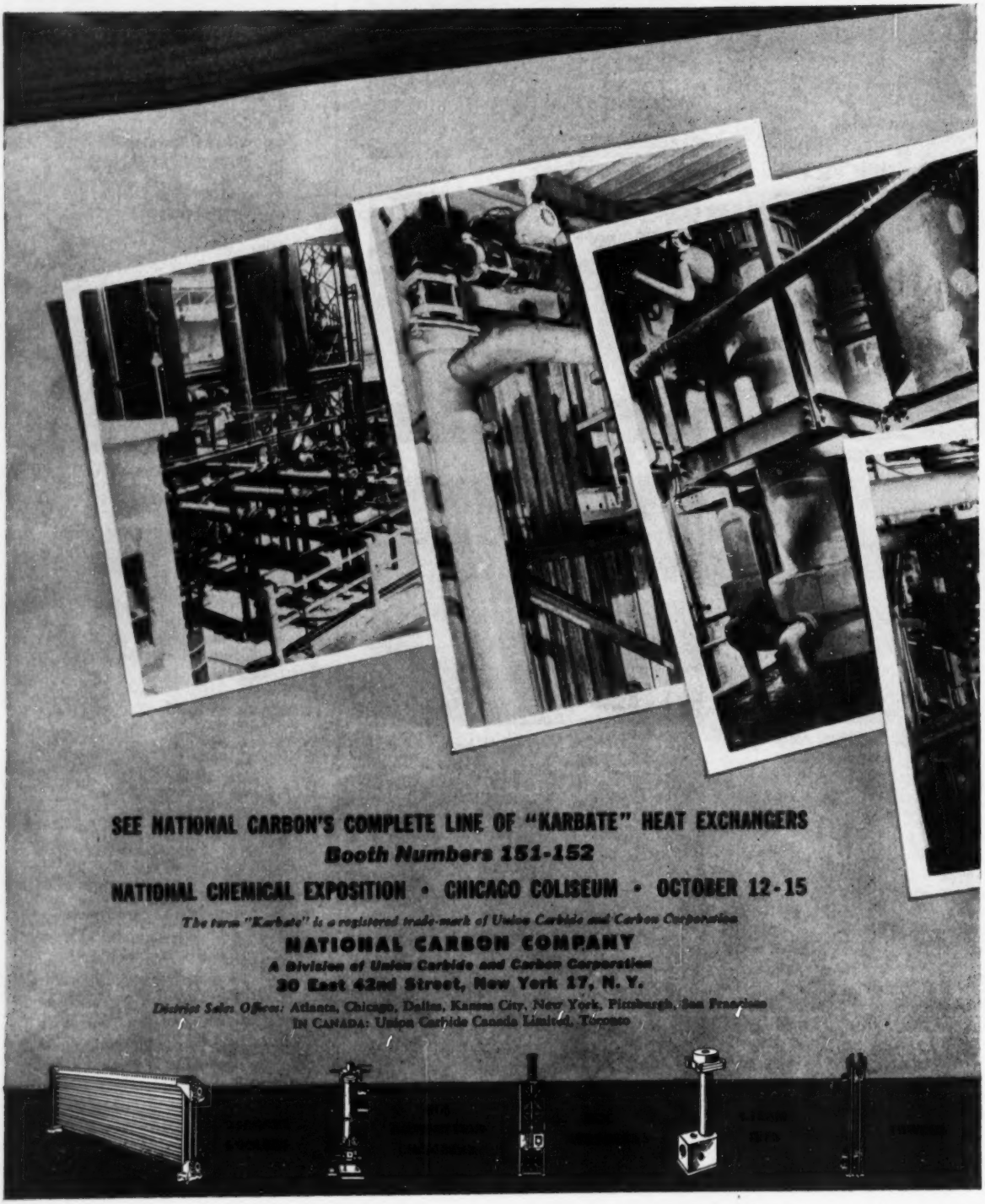
1885

INCORPORATED

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam
FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • **EXPORT DEPARTMENT:** New York City

THEY'VE CUT COSTS

IMPERVIOUS GRAPHITE



SEE NATIONAL CARBON'S COMPLETE LINE OF "KARBATE" HEAT EXCHANGERS

Booth Numbers 151-152

NATIONAL CHEMICAL EXPOSITION • CHICAGO COLISEUM • OCTOBER 12-15

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY

A Division of Union Carbide and Carbon Corporation

30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA: Union Carbide Canada Limited, Toronto

WITH "KARBATE" BRAND HEAT EXCHANGERS

YOU CAN, TOO – HERE'S WHY:

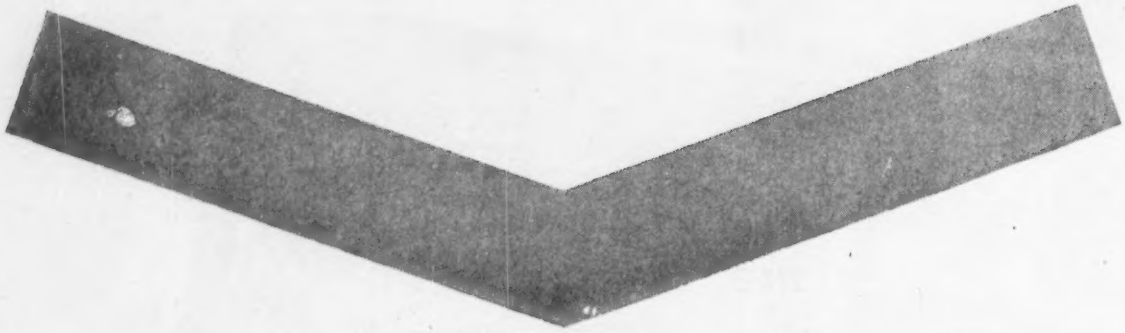
Economy – all the way down the line – keynotes NATIONAL CARBON'S standardization of "Karbate" impervious graphite shell-and-tube heat-exchangers, from the smaller, stock items to those providing as much as 2300 square feet of heat-transfer surface per unit.

COST LESS TO BUY: Producing and stocking proved designs in quantity, National Carbon offers "Karbate" shell-and-tube heat-exchangers at low first-costs and with even greater flexibility of application. For example, "Karbate" Series 90A and Series 310A heat-exchangers provide from 18 to 162 square feet of surface area in tube lengths from 6 to 16 feet, with a choice of 1, 3 or 5-pass tube-side arrangements, *all from stock*. Similarly, *stock* "Karbate" impervious graphite standardized tube-bundles and covers are used by leading heat-exchanger manufacturers in units of their own design, which offer a range of tube-surface areas from 80 to 2300 square feet in tube lengths to 16 feet. Shell-and-tube side-pass arrangements are virtually unlimited.

COST LESS TO USE: "Karbate" shell-and-tube heat-exchangers combine the complete corrosion resistance, high thermal conductivity, and immunity to thermal shock of "Karbate" impervious graphite with *designs* that are simple, rugged and versatile in application. The result – lowered operating costs and reduced maintenance, plus the *adaptability* so desirable in today's modern plant.



Only Brown flow meters offer you these profitable "*plus*" *values*

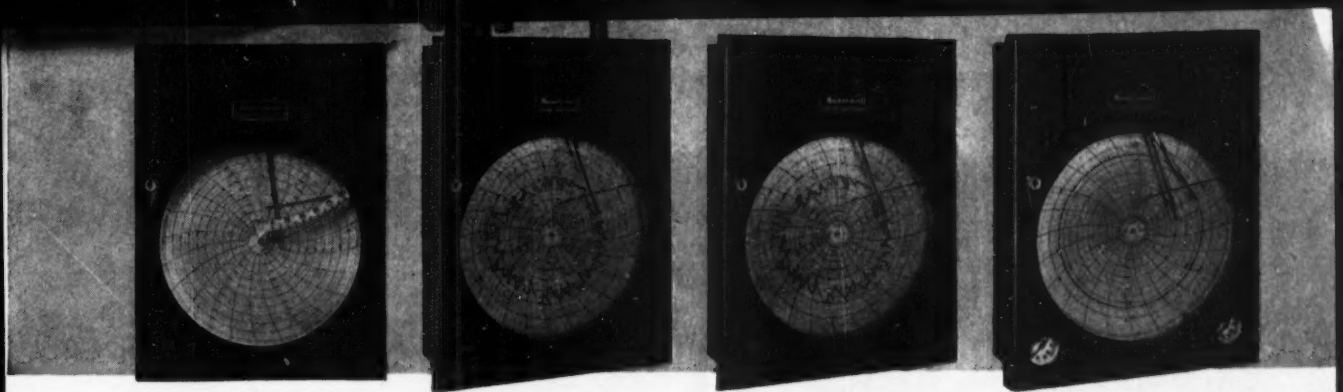


- ***16 different types*** of basic instrument systems . . . a flow meter for every fluid, every pressure, every operating requirement. *You're sure to find the most profitable meter for your specific application.*

- ***Nearby service facilities.*** There's a Honeywell service center as near to you as your phone. Service by factory-trained specialists is prompt, competent and economical. *You're sure to get maintenance and start-up service without delay.*

- ***27 years of experience*** in flow metering development and application work. *You're sure to get specialized engineering on your flow metering problem.*

- ***Nationwide field organization.*** Brown flow metering consultation is available from experts in more than 90 field offices, located near every major production center. *You're sure to have application engineering on hand where and when you need it.*

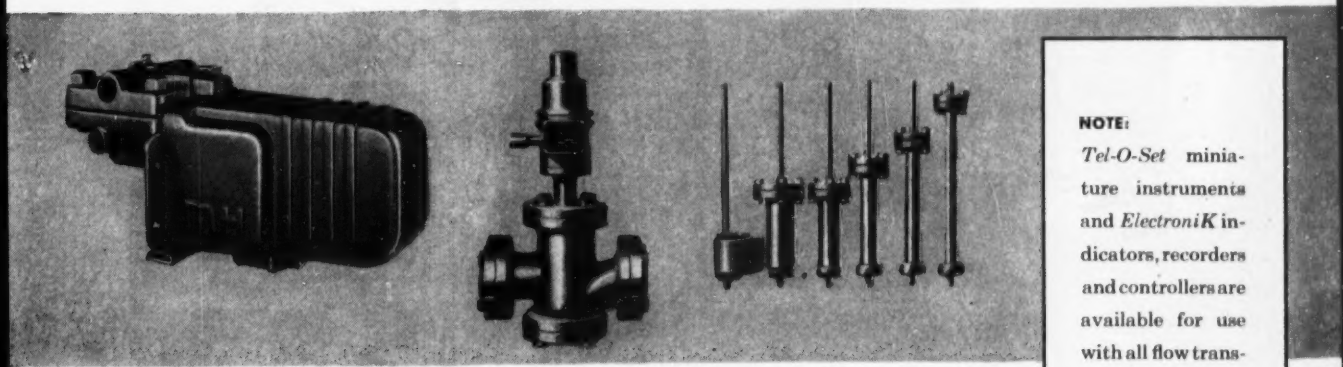


Linear scale meters—mechanical or electrical types, all control forms.

Square root scale meters—mechanical, or electrical or pneumatic transmission . . . all control forms.

Portable meters—versatility, for spot checks of flow values not continuously recorded.

Low pressure meters—either electrical or mechanical type, for air or gas flow.



Differential Converter—mercury-less pneumatic flow transmitter with infinitely adjustable range.

Area Type Meters for measuring flow of viscous fluids . . . electrical transmission.

Interchangeable range tubes typify rangeability of all Brown flow meters.

NOTE:
Tel-O-Set miniature instruments and *ElectroniK* indicators, recorders and controllers are available for use with all flow transmitters.

a flow meter for every fluid...

every application (all available with electronic integration)

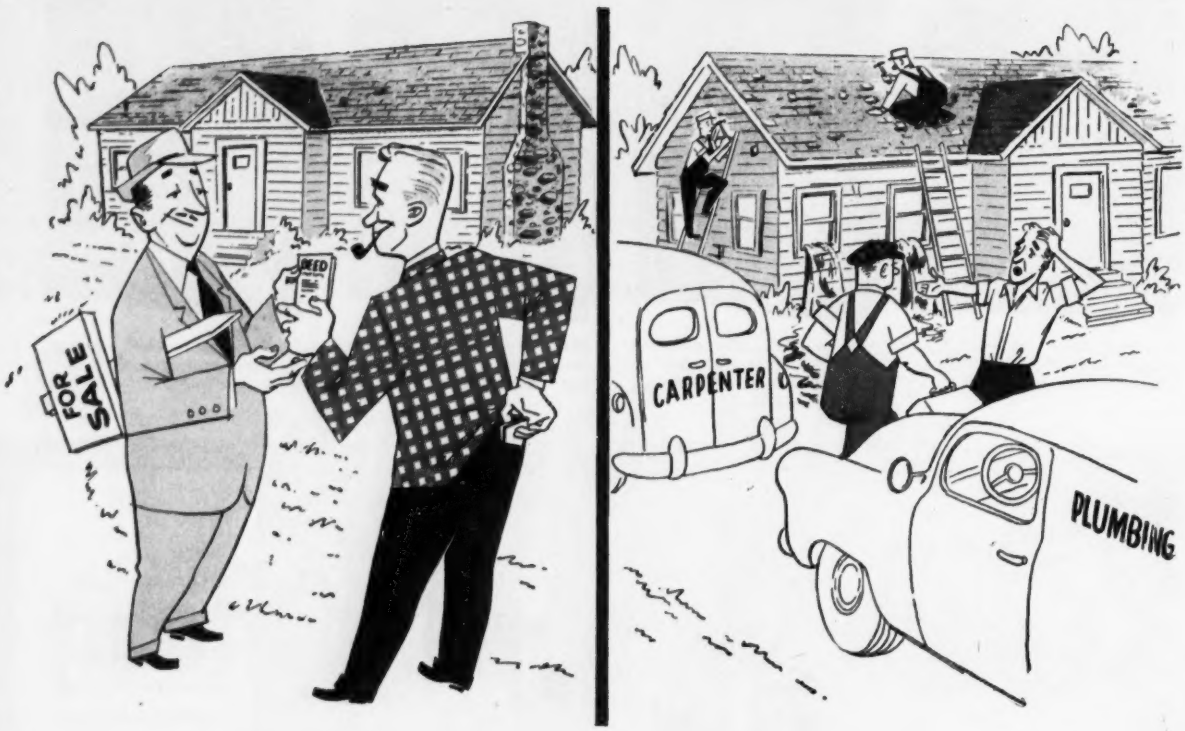
In PERFORMANCE, too, Brown flow meters provide you unsurpassed precision . . . reliability . . . convenience . . . with minimum maintenance requirements. In every way, you'll find it pays to select your flow meters from the one line that offers the most value.

Your nearby Honeywell sales engineer will be glad to discuss your specific flow application . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Integrating, Controlling."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



He bought it for a song...

It seemed a smart investment at first, but then he found out *why* the price was so low.

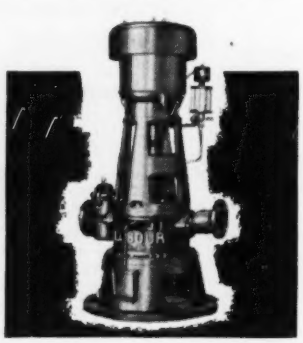
no repairs in seven years

A paint and solvent manufacturer who has purchased 7 LaBour Type G pumps over the past seven years, has not spent a single penny for repair parts. Since Type G is a packingless pump, the only maintenance expense has been for normal lubrication.

Of course he should have been able to ***see*** that a lot of work would soon be needed. But are you being any more cautious when it comes to buying corrosion-resistant pumps?

If you look, you can ***see*** that some pumps call for a lot more repair expense than others. We're pointing this out, naturally, because of the phenomenal service records established by LaBour Type G pumps—records which reduce over-all costs below anything ever seen before.

We can show you how to prove this for yourself, from your own records. Hadn't you better investigate?

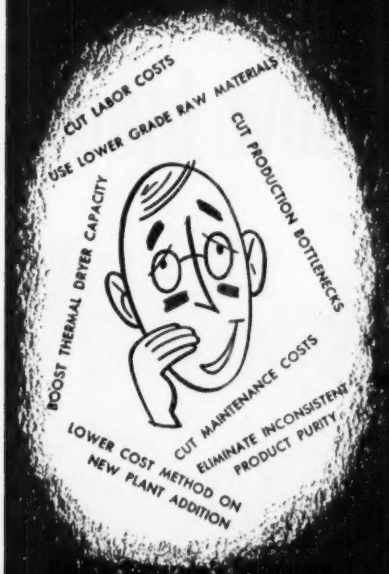


ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. • ELKHART, INDIANA, U.S.A.

Reineveld Centrifuge



The 16" Reineveld Laboratory Centrifuge, installed in Heyl & Patterson's Research Laboratory. This model, particularly designed for laboratory test work, is a valuable tool in plant laboratories for testing and for improving plant processes.

When you are faced with a processing problem concerning the separation of solids from liquids or the separation of two liquids, call on the test facilities of Heyl & Patterson and the 50 years of Reineveld's centrifugal experience.

Reineveld Centrifuge installations cover all types of products and difficulties from the fast dewatering of free-draining, large tonnage salt crystals to the extra-tough problem of dewatering Anthracene, a slow-draining, plastic-type crystal.

This abundant experience, combined with actual tests in Heyl & Patterson's testing laboratory, could provide the very answer you are looking for. Or, if your work is confidential, we will gladly offer suggestions for centrifuge testing in your own laboratory.

Whenever you are confronted with new or unusual processing problems, remember Heyl & Patterson testing facilities.

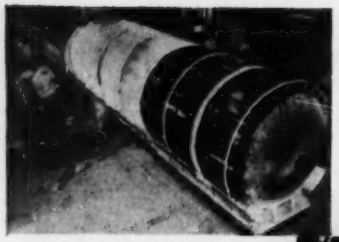
Write for Booklet 10-RC-2

Heyl & Patterson, Inc.

"SINCE 1887"

55 WATER STREET · PITTSBURGH 22, PA.





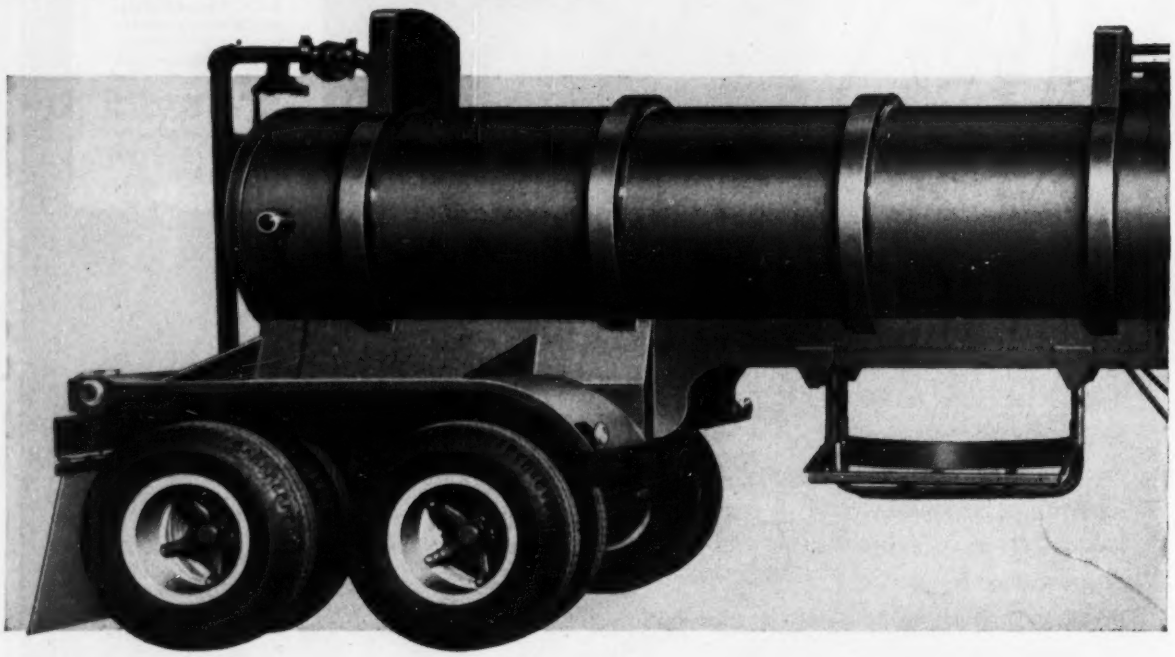
New Trailmobile Design

Rigid and continual inspection during assembly of Trailmobile Acid Tanks assure long service life, safe operation.



Continuous automatic weld areas can be seen on new acid tank under construction at Trailmobile's exclusive tank manufacturing plant, Springfield, Mo.

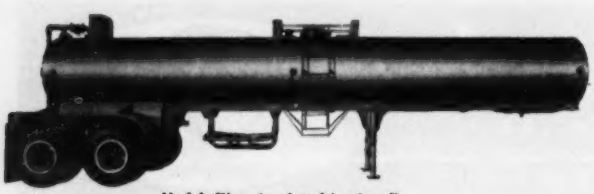
The New Model



You can haul more in Trailmobile's new "slimmed down" Model CH Acid Tank Trailer. Model CH is lighter by thousands of pounds, without sacrifice of structural strength, load safety or road handling ease.

Trailmobile's weight-reducing secret is a strong tank shell of 3/16" A.S.M.E. Code Steel, girded by husky "rings of steel." Strong channel members (we call them exterior rings) are welded integrally to the tank shell and sturdy supporting frame members. Result? Overall structural strength equal to all previous regulations! Amazing weight reduction!

This exclusive new Trailmobile Model CH design (approved by I.C.C. Specification MC-311) gives operators extra payload carrying capacity of over 100 pounds for every 100 gallons of capacity built into a tank. A 3000 gallon capacity

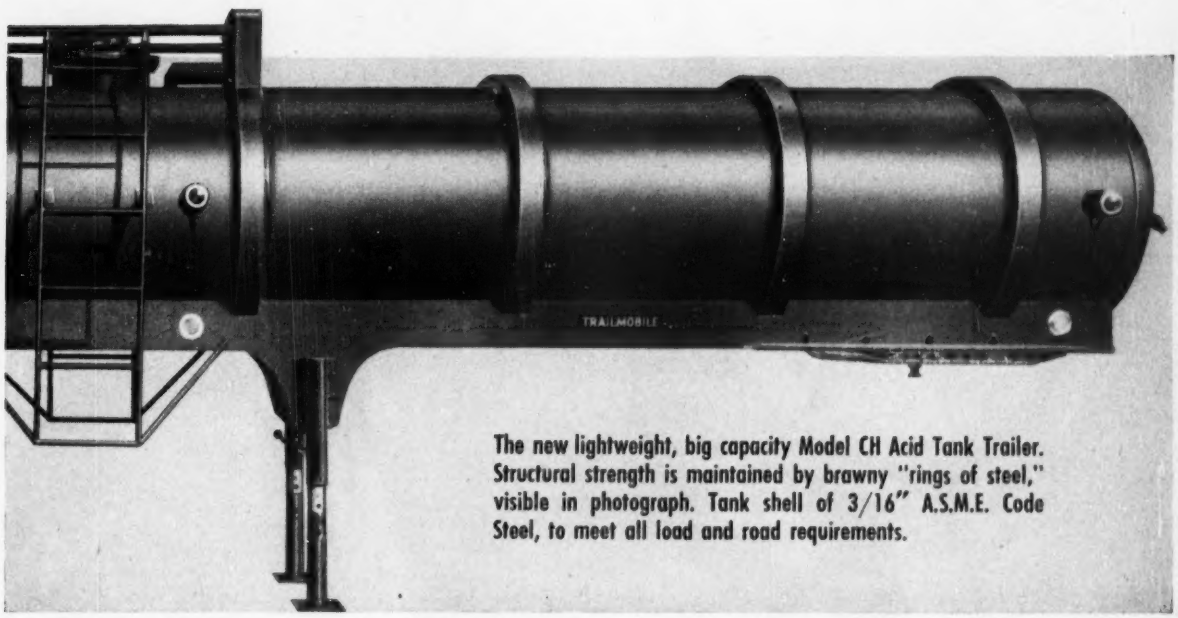


Model CH — insulated (optional)

Trailmobile continues to build heavier gauge tank trailers. Acid tanks are available in many sizes, shapes and designs with special and optional equipment to handle exact hauling problems. Ask about these special tanks.

Gives 3000 lbs. More Payload

CH Acid Trailer ... give you extra payload carrying capacity without sacrifice of structural strength or road safety!



The new lightweight, big capacity Model CH Acid Tank Trailer. Structural strength is maintained by brawny "rings of steel," visible in photograph. Tank shell of 3/16" A.S.M.E. Code Steel, to meet all load and road requirements.

tank weighs almost 3300 pounds less than before. You get a bonus of 3300 pounds more payload! What's more, the new Model CH acid tanks encompass every money-saving performance feature of previous Trailmobile models: Walkway mounting brackets; adjustable fifth wheel; full Class A vapor-proof enclosed wiring; wide tunnel drains for easy cleaning; the famous Trailmobile tandem, with 4', 6' and 9' options.

Trailmobile manufactures the Model CH Acid Tank in either stainless or black steel, and with a variety of coatings and linings to handle all types of corrosive and non-corrosive fluids. So whatever your acid hauling problem, see Model CH before you buy. It's your assurance of increased hauling capacity, with utmost safety, economy and profit.

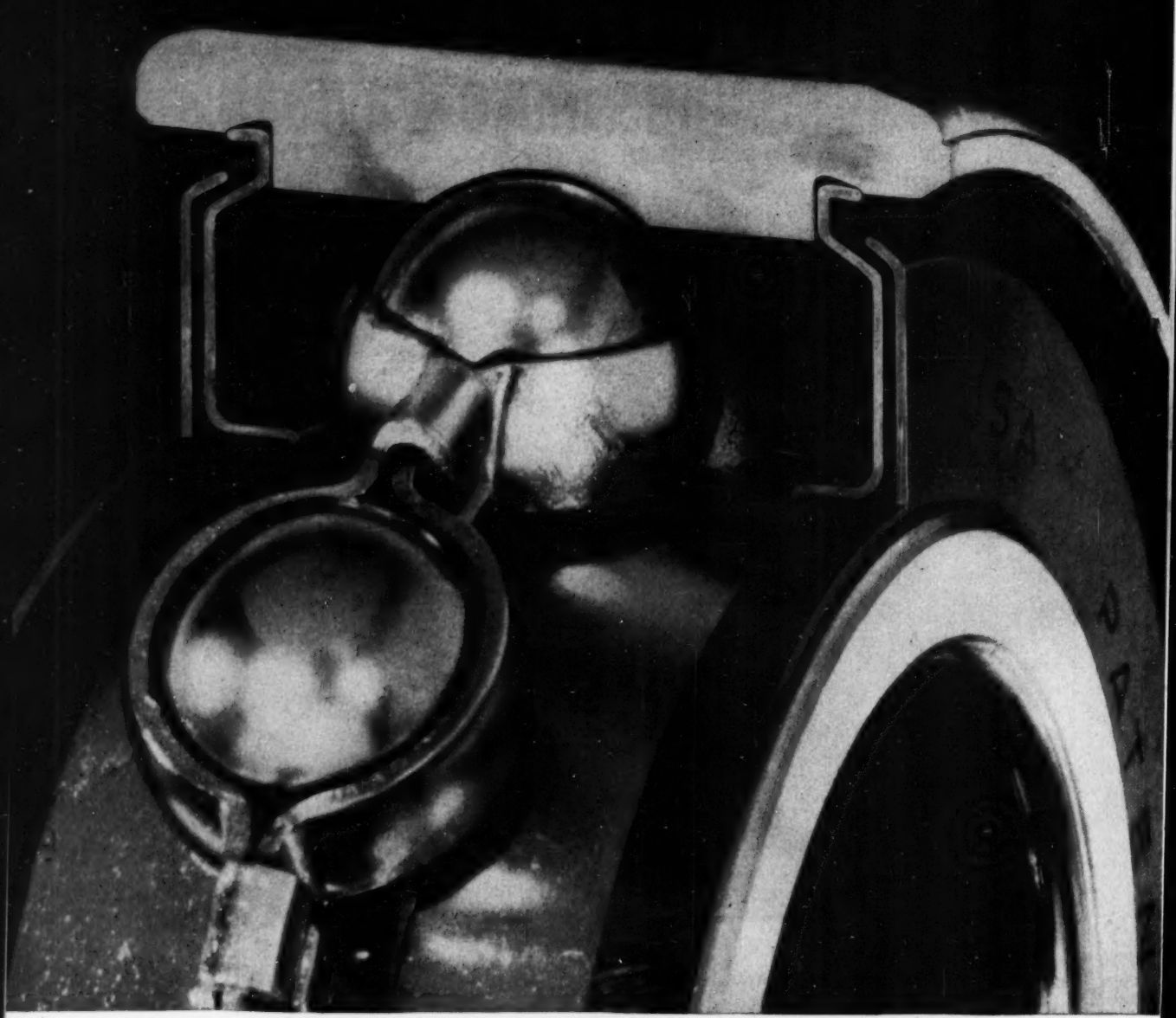
For full information and quotations on the Model CH and other Trailmobile Acid Tank Trailers, get in touch with us. Or, check the yellow pages of your phone book for the location of your nearest Trailmobile Branch Office.

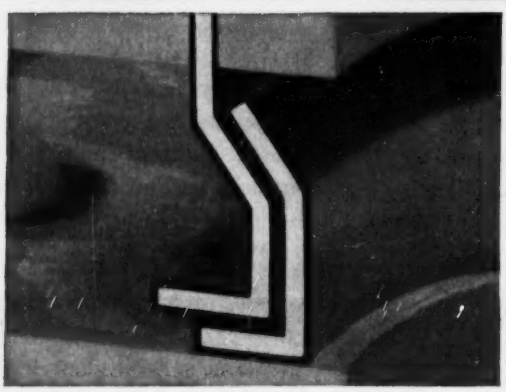
TRAILMOBILE INC.

The Trend is to **TRAILMOBILE**

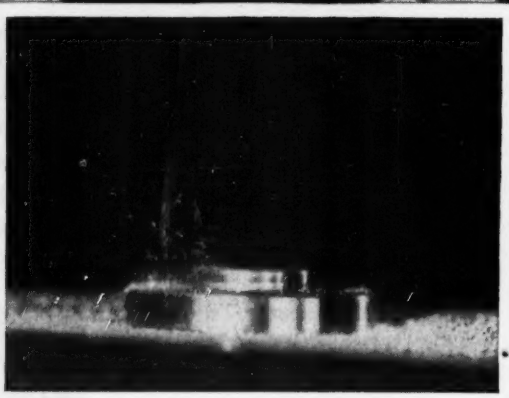
Subsidiary of Pullman Incorporated

CINCINNATI 9, OHIO • SPRINGFIELD, MISSOURI • BERKELEY 10, CALIFORNIA





POSITIVE LABYRINTH. A joint is only as effective as its seal. Countless research studies have shown that the labyrinth is one of the most effective ways to seal a joint where at least one member rotates. Further sealing action is achieved by the film of grease that fills the minute clearance between the two seals.



FLINGER ACTION. One of the most important functions of the outer rotating seal is to throw off any foreign element that tries to enter the bearing. This flinger action is achieved by the centrifugal force set up by the rotating seal. Elements attacking the bearing are repelled.

Exclusive 4-way seal guards new Life-Line A bearing



Here's why you can count on reliable Life-Line A motor performance

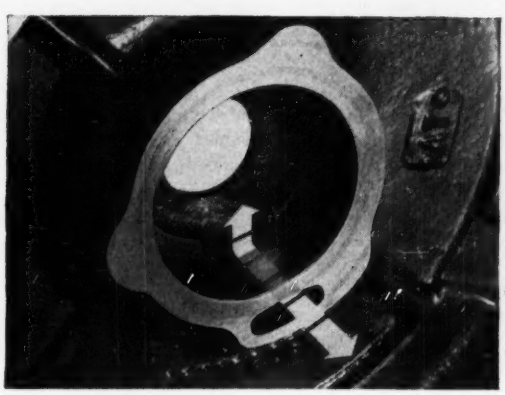
There are three factors that affect motor bearing life: (1) type of lubricant, (2) amount of lubricant, and (3) presence of contaminants. The one *sure* way to control all three is to use a bearing that is pre-lubricated at the bearing manufacturer's plant and then SEALED.

Many of the original Life-Line® pre-lubricated bearings installed in 1937 have been running ever since and are still like new. Now, Westinghouse offers another important step ahead... a pre-lubricated motor bearing that has *four* seals... two on each side. Here's real bearing protection. Grease is sealed in. Contaminants are sealed out. No on-the-job greasing is required—EVER.

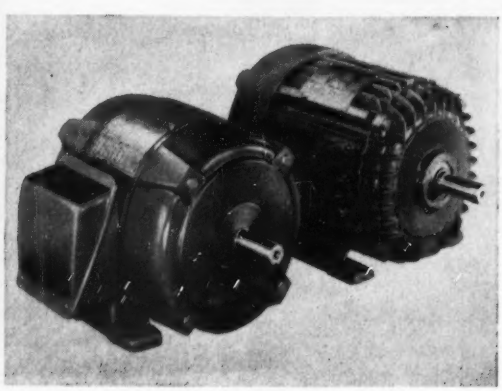
This new concept in motor bearings is one of the many improvements Westinghouse has incorporated into the complete, balanced design system that makes the Life-Line "A" motor your best buy. Get all the facts from your local Westinghouse sales engineer. Or write for Booklet B-6154-A. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21849

YOU CAN BE SURE... IF IT'S

Westinghouse

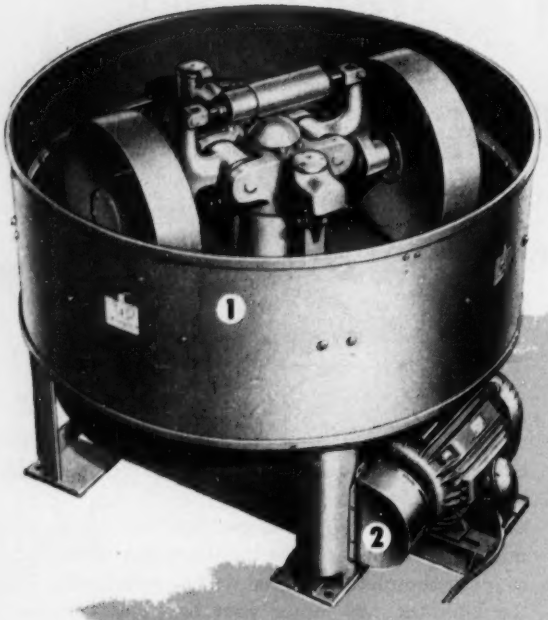


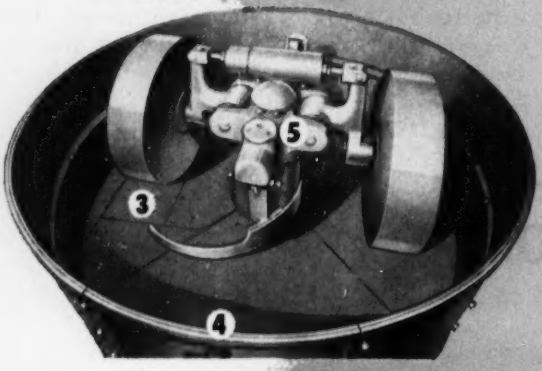
AIR BY-PASS. Totally-enclosed motors "breathe" as the internal air expands and contracts with change in temperature. Ordinary motors "breathe" along the shaft and through the bearings. Life-Line provides an air by-pass around the bearings to keep out contaminating air.

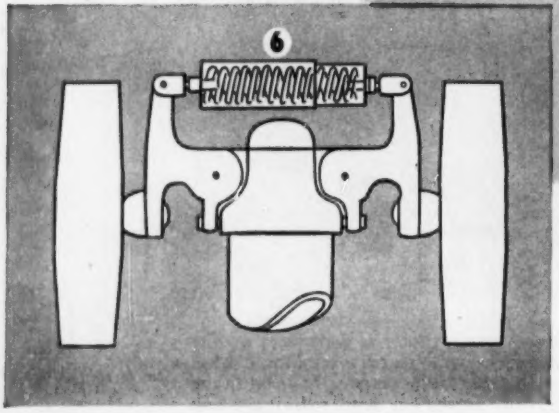


The performance of any motor is dependent on the performance of each component of that motor. It takes balanced design. That's why every component in the new Life-Line "A" motor has been redesigned and integrated with the whole. The result is a motor with superior performance and consistent dependability.

SIMPSON







SIMPLE, RUGGED and EFFICIENT... TO PAY DIVIDENDS IN MORE AND BETTER MIXING FOR EVERY DOLLAR INVESTED

1 STATIONARY PAN

No power required to move heavy machinery components or large material mass — insures low maintenance — long life.

2 V-BELT DRIVE

Assures positive drive, protection against sudden overloads . . . easy repairs.

3 BOTTOM DISCHARGE

A Mix-Muller advantage! No additional power required — mixing action automatically and quickly sweeps pan clean when discharge door is opened.

4 EASY ACCESS

1½F, 2F and 3F Models have removable crib section — all interior parts can be quickly serviced . . . easily removed.

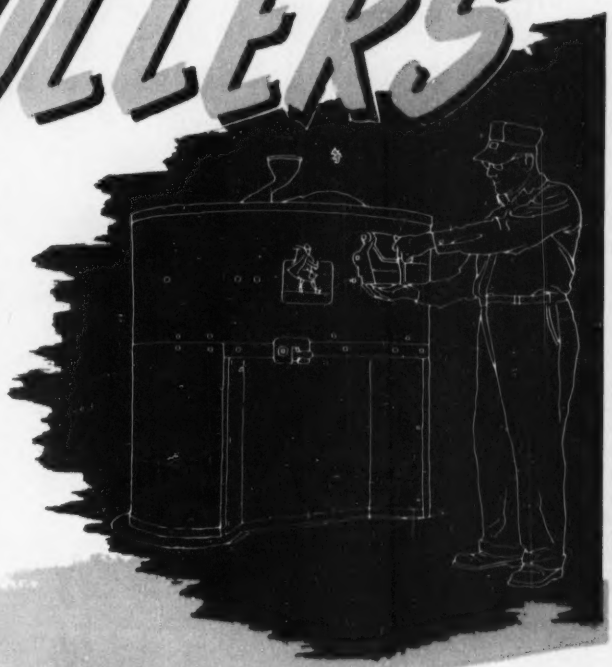
5 CENTRALIZED LUBRICATION

All moving parts (in pan) can be lubricated at one location. Saves time, effort, assures regular lubrication. Exclusive on 2F and 3F Models.

6 SPRING LOADED MULLERS

Adjustable spring tension provides infinitely variable control over muller pressures. Another exclusive Mix-Muller feature and a big plus for positive control over quality.

MIX-MULLERS



Increased emphasis on speed, quality of production and improvements in the design and efficiency of materials handling equipment have combined to place more and more importance on the efficiency of your mixing operations. In addition to a high quality, thorough mixing job, today's processing needs call for a steady uninterrupted flow of production.

Here are six outstanding features of the new Simpson Mix-Muller . . . six *good* reasons how and why their simple, rugged and practical design assure the kind of low maintenance, high production and economy of use that make them today's *top* investment in mixing efficiency.

LOW MAINTENANCE

Simple, *practical* engineering principles, an uncomplicated mixing action and 40 years of practical mixer engineering offer the Mix-Muller user a real bonus in low maintenance . . . and long life.

MULLING ACTION

In the Simpson a unique smearing, spatulate action works on *each* grain of material. More than a mixing action, Simpson *mulling* serves to quickly and intimately *blend* materials rather than stirring them up or placing them *next* to each other. Mix-mulled products won't segregate in storage or transit either.

ALL POWER USED TO MIX

Stationary pan, bottom discharge and *free* rolling mullers mean that all power is used to *mix*—not to discharge . . . not to move heavy masses of material.

WIDE RANGE OF CAPACITIES

Available in batch capacities of from 1/10 to 60 cu. ft. there is a Mix-Muller for your specific requirement for preparing any dry, wetted or plastic material. Write today for details and remember . . . mixing is our business . . . our principal business since 1914.

SEE

MULLING

DEMONSTRATED

Don't miss mulling at the Chicago Chemical Show Oct. 9-16! It's your chance to see for yourself how a Simpson Mix-Muller can fit into your production picture. See us in Booth 141 or write first, stating your requirements . . . a National Engineer will discuss them with you personally.

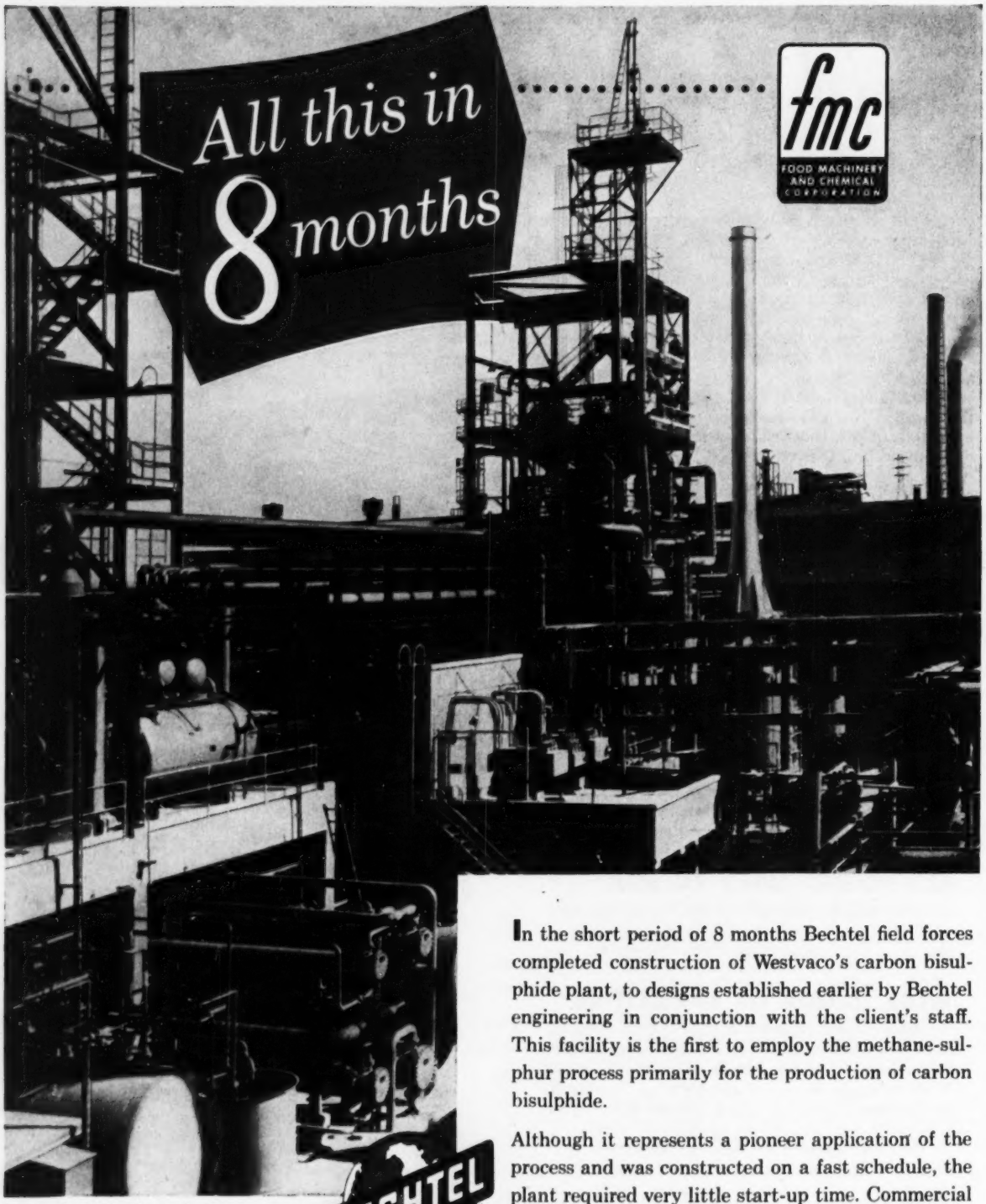


SIMPSON *MIX-MULLER*® DIVISION

NATIONAL ENGINEERING CO., 604 Machinery Hall Bldg., Chicago 6, Ill.

(Not Inc.)





Increasing Charleston's fame as a center of industrial chemistry—new carbon bisulphide plant of Westvaco Chlor-Alkali Division, Food Machinery and Chemical Corporation.

In the short period of 8 months Bechtel field forces completed construction of Westvaco's carbon bisulphide plant, to designs established earlier by Bechtel engineering in conjunction with the client's staff. This facility is the first to employ the methane-sulphur process primarily for the production of carbon bisulphide.

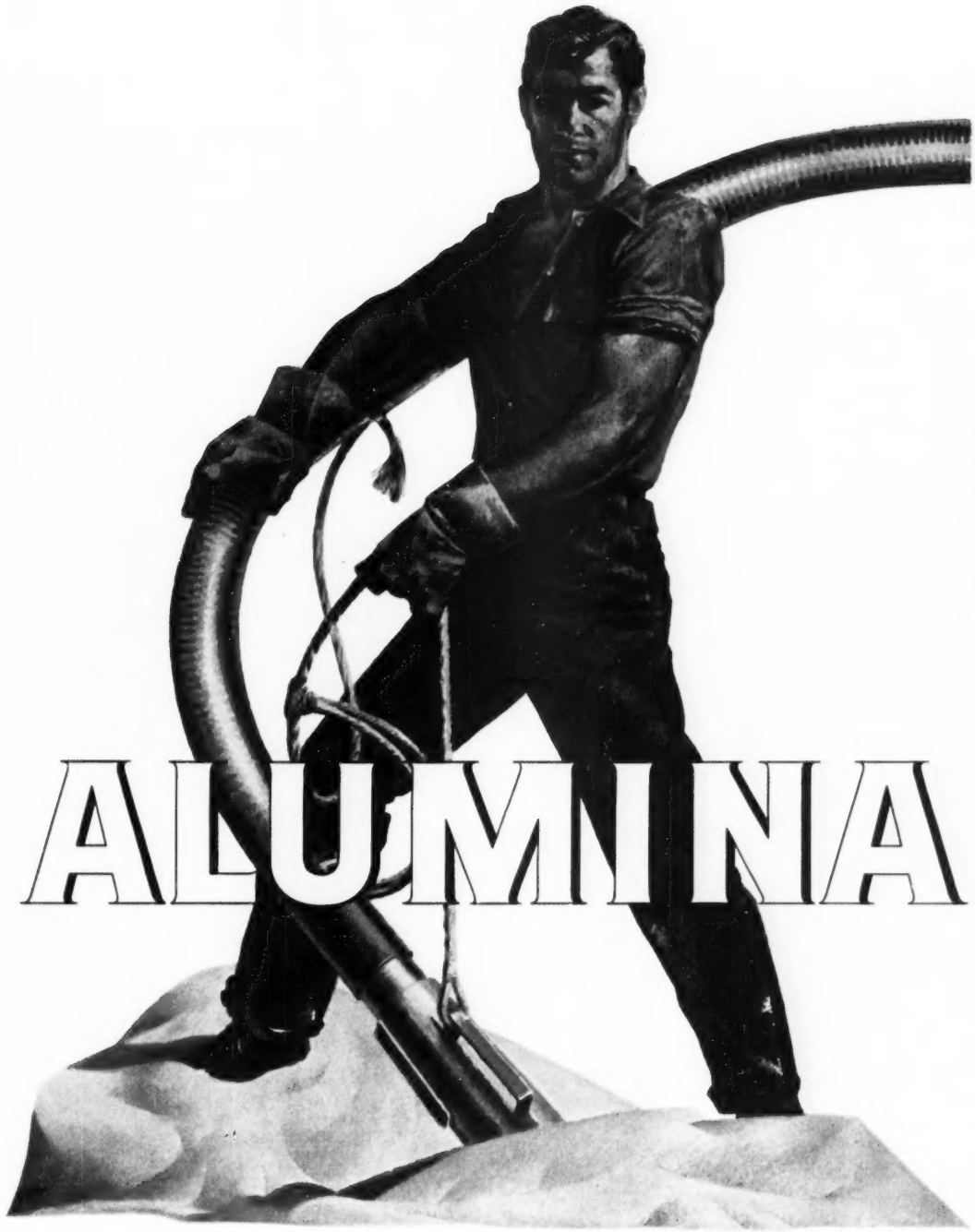
Although it represents a pioneer application of the process and was constructed on a fast schedule, the plant required very little start-up time. Commercial operation began almost immediately—and the product has been consistently high in quality.

The ability to compress schedules is an important advantage when early production is desired.

BECHTEL

BUILDERS FOR INDUSTRY

BECHTEL CORPORATION *Los Angeles* · **SAN FRANCISCO** · *New York*



When you specify Kaiser Alumina your order gets immediate, individual attention! You get prompt delivery—often overnight in emergencies. And you get experienced technical service.

That's why Kaiser Chemicals is a major supplier of calcined, hydrated, and active aluminas serving the majority of the nation's users.

Call or write *Kaiser Chemicals Division*, Kaiser Aluminum & Chemical Sales, Inc. Regional sales offices: OAKLAND 12, California, 1924 Broadway . . . AKRON 8, Ohio, First National Tower Bldg. . . . CHICAGO, 518 Calumet Bldg., 5231 Hohman Ave., Hammond, Indiana.

Kaiser Chemicals

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ALUMINA • BASIC REFRACTORY BRICKS AND RAMMING MATERIALS • DOLOMITE • MAGNESIA • MAGNESITE • PERICLASE

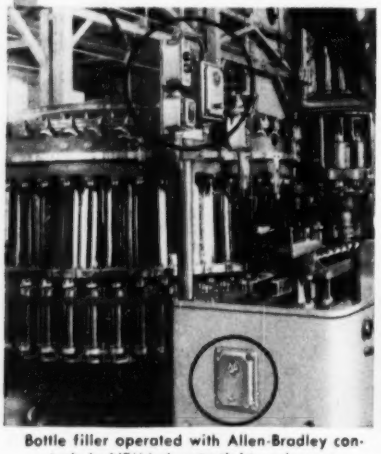
Allen-Bradley Trouble Free Starters for the Chemical and Process Industries

Wherever you find outstanding industrial equipment, you will discover reliable Allen-Bradley motor control. There is a reason!

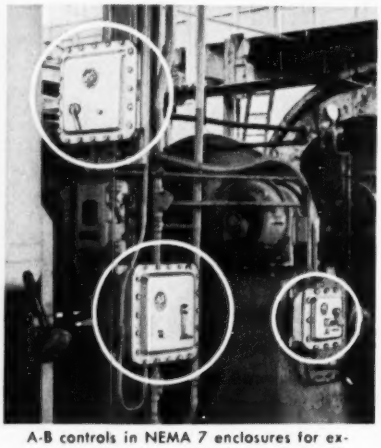
The simple solenoid design—only ONE moving part—is your reliable guarantee for millions of trouble free operations. When you eliminate moving or wearing parts, like pins, pivots, linkages, and bearings, you automatically eliminate possibilities for trouble. Also, Allen-Bradley controls require no contact maintenance. The double break, silver alloy contacts never need filing, cleaning, or dressing. Nor is regular inspection necessary! The contacts are always in perfect operating condition.

Thus, in explosive, dutsy, or moist atmospheres, it pays to install Allen-Bradley starters in the correct enclosure. Because Allen-Bradley solenoid controls do not require regular inspection, time lost in removing and replacing bolted covers is substantially reduced. Ask any maintenance man!

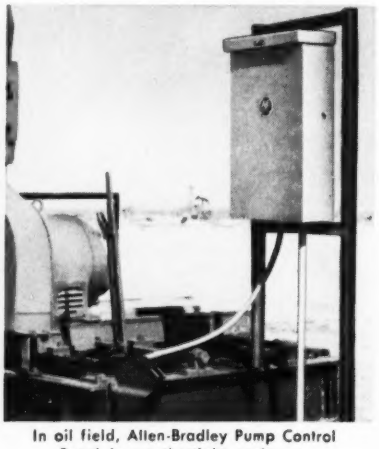
Allen-Bradley Co., 1337 S. First St., Milwaukee 4, Wisconsin
In Canada—Allen-Bradley Canada Limited, Galt, Ontario



Bottle filler operated with Allen-Bradley controls in NEMA 4 watertight enclosures.



A-B controls in NEMA 7 enclosures for explosive atmospheres installed on ball mill.

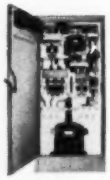


In oil field, Allen-Bradley Pump Control Panel in weathertight enclosure.

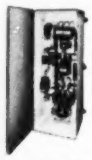
The Sign of Quality

A-B Quality

Typical Starters



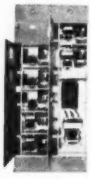
Synchronous Starter



Reduced Voltage Starter



High Voltage Starter



Control Center



Solenoid Starter

Allen-Bradley Solenoid Motor Control

RESULTS OF AN INTELLECTUAL REVOLUTION . . .

"The Western Miracle" Continues . . . More Automatic Controls for Industry

Within recent weeks three new monthly technical magazines devoted to automatic control systems for industrial processes and machinery have offered the public their first issues. One of these is CONTROL ENGINEERING, a McGraw-Hill publication.

What has caused this surge of interest in the design and application of automatic control systems? What does it portend for the future of American industry? More important, what does it promise for the American standard of living, of which industry is and must be the servant? And what is the role of CONTROL ENGINEERING in this development? It is to those questions that this statement is addressed.

A New Intellectual Revolution

It is frequently asserted that we are now in the throes of a new industrial revolution. The revolution is described as the eliminating of wasteful applications of human labor to repetitive tasks through new technology which makes it possible to transfer those tasks to automatically controlled machinery.

It is perhaps more accurate, however, to say that we are the beneficiaries of a new intellectual revolution in the application of science to industry. This new intellectual revolution points the way toward giant strides in the continuing process of taking dull and laborious work off the backs and minds of men and transferring it to machines operating in large batteries under automatic control.

The practical engineering work required to convert this intellectual revolution into a full-scale industrial revolution, however, in large part still remains to be done. It is to this task that CONTROL ENGINEERING will be devoted. Its role is that of bridging the gap, in engineering and economic terms, between the new conceptions of automatic control of industrial processes and their practical workaday application. These conceptions run the full gamut from systems of control for automatic factories making heavy industrial products to highly personalized systems of automatic control to warn people when they are approaching the broiling point in sunning themselves at the beach or becoming too drowsy to drive their cars safely.

Enter the "Feed-Back" System

Enough work has been done to move these conceptions out of the realm of interesting dreams and into the realm of practical possibilities, and in some cases into the realm of practical realities. Crucial parts of this work were done during World War II when weapons were successfully equipped with "feed-back" systems

that automatically corrected mistakes made by the weapons in locating their targets.

The principle of the "feed-back" system is as ancient as the personal monitor that tells us not to run into each other as we walk along the street. It feeds back to our locomotion machinery the warning of a collision ahead. But the application of the principle to weapon control and then to more general machinery control required superlatively imaginative and skillful scientific development.

When a "feed-back" system that monitors an automatic process and keeps it lined up precisely is teamed up with a computing machine, capable of making lightning calculations that control both what goes into the process and what is done with the product, the horizons of automatic control become broad indeed. But in large part they still remain horizons. A vast range of practical engineering work remains to be done to realize anything like the full potential of automatic control of industrial processes and machinery.

More and Better Jobs

There are those who view the surge of interest in automatic control with alarm. They conjure up a situation in which automatic processes will at once expand the ranks of the unemployed and reduce many of those still working in industry to the status of robots or automatons.

A look at the record of the American economy — a record of amazing growth, steadily improving job opportunities and a constantly rising standard of living — demolishes the basis for such fears. The introduction of new and more efficient industrial machinery and processes obviously cannot be accomplished without creating some disturbance for some individuals and some companies. But consistently the longer range effect of such local and temporary disturbance has been more jobs and better jobs for Americans.

It is no accident that, while the proportion of industrial wage earners in our population is virtually the same as it was in 1920, the proportion of professional and salaried workers has doubled. The proportion of unskilled workers, furthermore, has dropped by half. This has been an essential part of a continuing process by which drudgery has been transferred to machines while the workers who formerly did the drudgery have been graduated to jobs calling for greater competence and providing better pay.

Higher Living Standard

A British historian, H. J. Hancock, has referred to this general process as "the Western miracle"—that of providing an ever higher and higher standard of living for more and more Americans. The key element in this miracle has been more and more reliance on power-driven machines to get the day's work done.

In the nature of the extremely complicated apparatus involved, full development of systems which have passed through the "think stage" into the status of practical possibilities will be a time-consuming process. It will also be a very exacting process, calling for a tremendous application of engineering skill and ingenuity. However, the engineers who are concentrating on this difficult, workaday phase of the development of apparatus for automatic control will be inspired by the knowledge that they are making a crucial contribution to technical progress which holds great promise of good for the American people.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

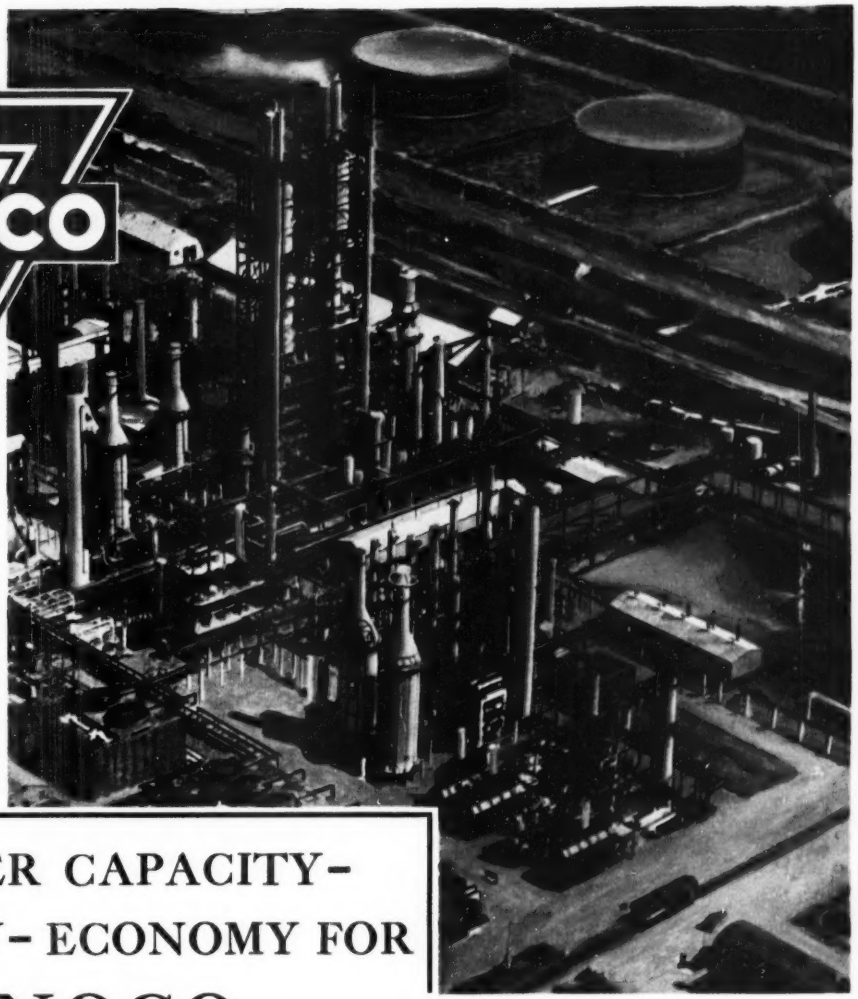
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Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

CONOCO



New installations recently placed in operation at Lake Charles, include units for crude oil distillation, catalytic cracker feed preparation, Thermofor catalytic cracking, gas recovery, catalytic polymerization, catalytic reformer feed preparation and aromatics extraction.

GREATER CAPACITY– EFFICIENCY– ECONOMY FOR CONOCO



For Continental Oil Company, Stone & Webster Engineering Corporation designed and constructed seven types of process units and enlarged an existing alkylation unit at the Company's Lake Charles, Louisiana, refinery.

Continuous flow through several of the units minimizes the need for intermediate offsite storage facilities; and all units are closely integrated for high heat economy.

These new units more than tripled the capacity of the refinery.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

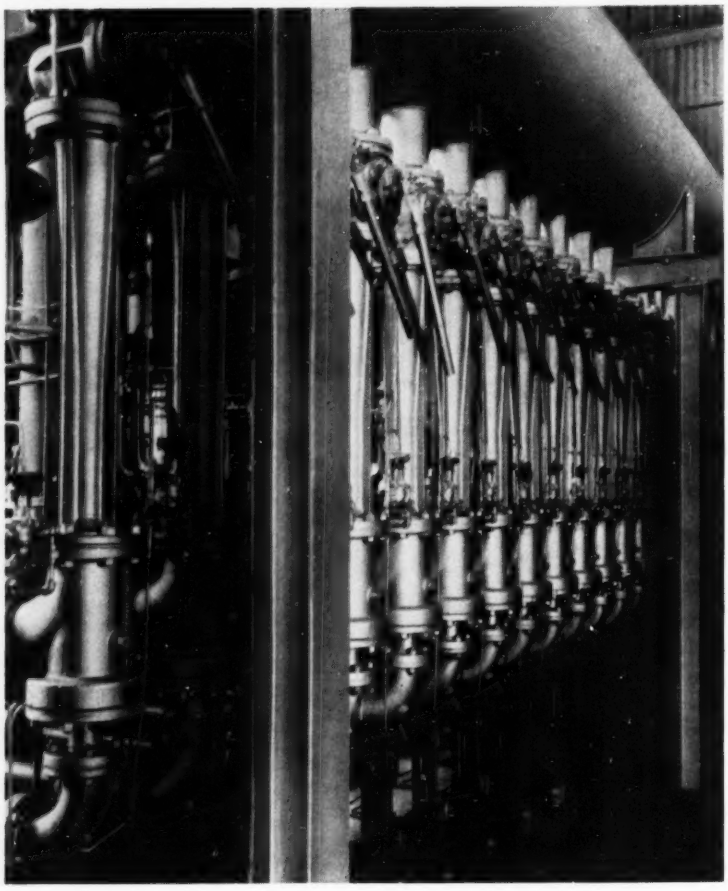
STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Toronto

PIPE ORGAN FOR HOT TUNES



I-R Ejector Jets automatically maintain desired BTU content of gas mixture for firing metallurgical furnaces at Fairless Works.

The pipes in this "organ" produce no music. Yet the steady roar of gases which they control is music to the ears of the utility men at U. S. Steel's new Fairless Works. For this bank of fifteen I-R ejectors plays a major role in keeping the furnace fires burning at constant, high efficiency.

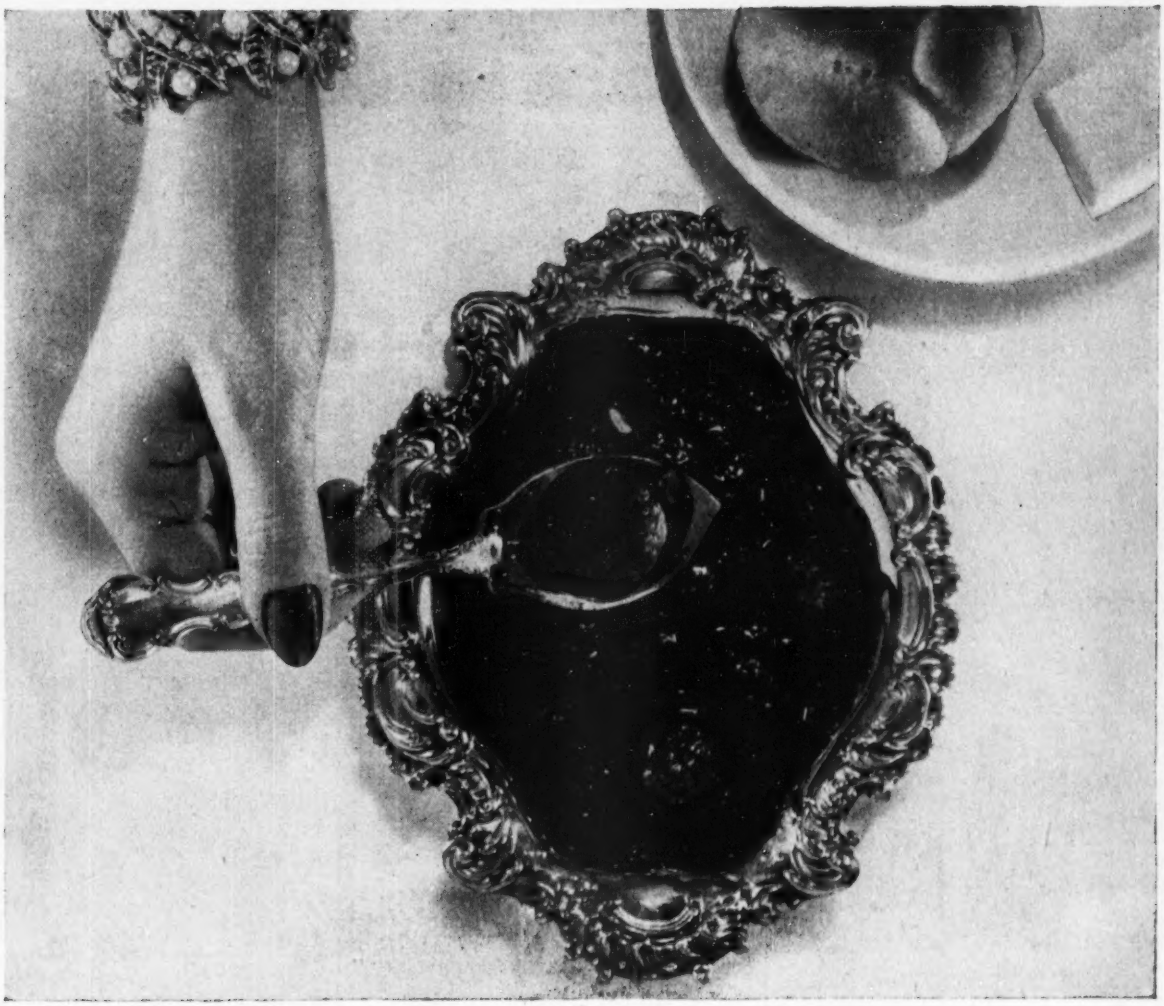
The reheating and pit furnaces at Fairless normally burn coke oven gas. At times, however, there isn't enough of it and natural gas must be introduced as fuel. If the natural gas were burned in its virgin state the burners would have to be readjusted every time, since coke oven gas has only half the BTU value of natural gas. That's where the jets come in. They mix just enough air with the natural gas to give it the same heat flow factor as coke oven gas. The natural gas is expanded through the nozzle of the jet, picking up air through the suction. Gas flow is regulated automatically according to load requirements by cutting any of the fifteen jets into or out of the system.

This is another example of how Ingersoll-Rand experience in the design and engineering of steam jet ejectors was able to solve a specific operating problem. The same time-saving, cost-saving service is available for *your* problems, too. Just call your nearest I-R representative or branch office.

Ingersoll-Rand

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"Million Dollar Magic"

KEEPS THE FLAVOR JAM-DANDY!

Mm-m-m-m! Delicious jams and jellies with that "just right" flavor. And Swenson engineering "magic" helps keep the flavor full and natural through the improved production of *pectin* for the food industry.

Because pectin is highly sensitive to heat which decreases gel strength and damages flavor, accurate time and temperature control is essential in the concentration of the pectin liquors. Swenson engineers, using the Swenson Long Tube Vertical Evaporator, developed a single pass cycle for each evaporator effect . . . reducing heat exposure time to a minimum, permitting the use of rapid, high temperature evaporation with complete safety. The result was *improved* lower cost pectin.

Swenson's "million-dollar magic" has helped many leading processors achieve better results and bigger profits. *Next could be your product!* Why not discuss it with a Swenson engineer now . . . write to:

SWENSON EVAPORATOR COMPANY
15669 Lathrop Avenue, Harvey, Illinois

SWENSON

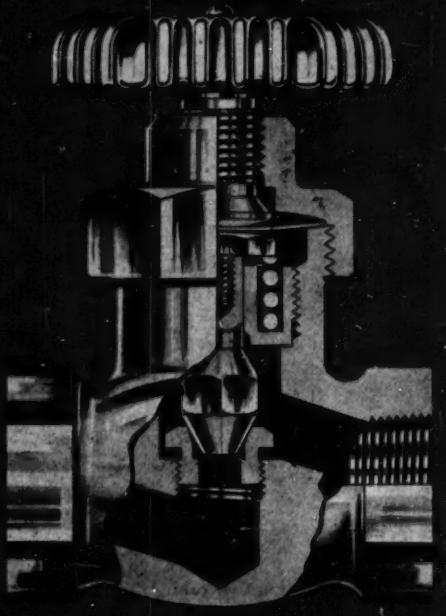
Proved Engineering for the Process Industries
SINCE 1889

A Division of Corporation



Evaporators Crystallizers Spray Dryers Filters

for control

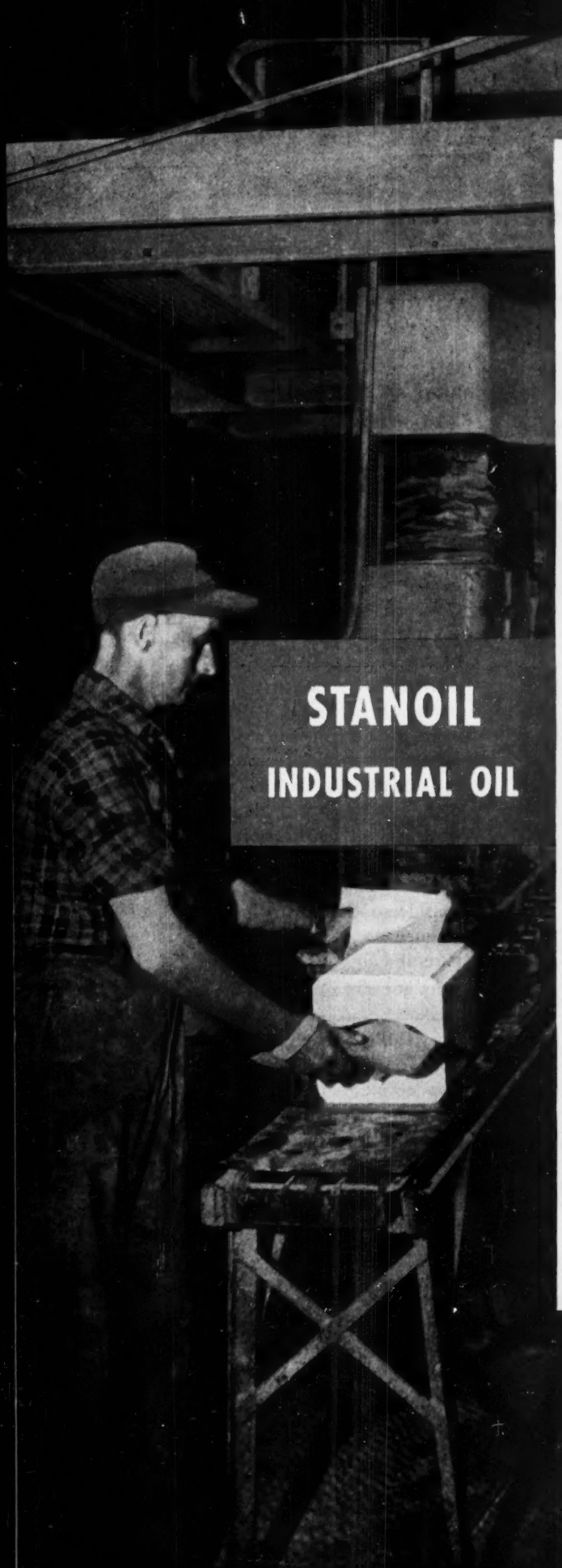


The Kerotest 7900 Packless Metering valve is designed for exacting control and regulation of gases and liquids at high and low temperatures. Rugged construction featuring a Stainless Steel needle type stem and a replaceable Monel seat make this an ideal valve for laboratory and industrial chemical plant installations. This Kerotest design permits vacuum service applications to 50 microns absolute. Available in ¼", ⅜", and ½" Female Pipe connections.

KEROTEST

MANUFACTURING COMPANY

2523 LIBERTY AVENUE · PITTSBURGH 22, PA.





How a good oil earns its salt!

Here's a "salty" story about an oil with staying power. When this 100 ton hydraulic press was to be installed by the Morton Salt Company in their Manistee, Michigan plant, officials outlined to a Standard Oil lubrication specialist some of the rigid specifications the required oil should have. The new press would operate under a heavy load five days a week, and since the original fill would be large — 22 barrels — it was important that the oil installed resist oxidation and remain in good condition for long periods.

The Standard man recommended STANOIL Industrial Oil #25, a many-purpose oil having high stability and effective rust protection. In over seven years of hard service, the oil has never been changed! During this period, periodic tests of oil samples have shown that STANOIL, despite hard service and high oil-operating temperatures, has maintained a lubricating quality comparable *with a new oil.*

For information on how *you* can best use STANOIL in *your* plant, check with a specially trained and experienced Standard Oil lubrication specialist. He can help you save time and money. Call your nearest Standard office, or write to Standard Oil, Chicago.

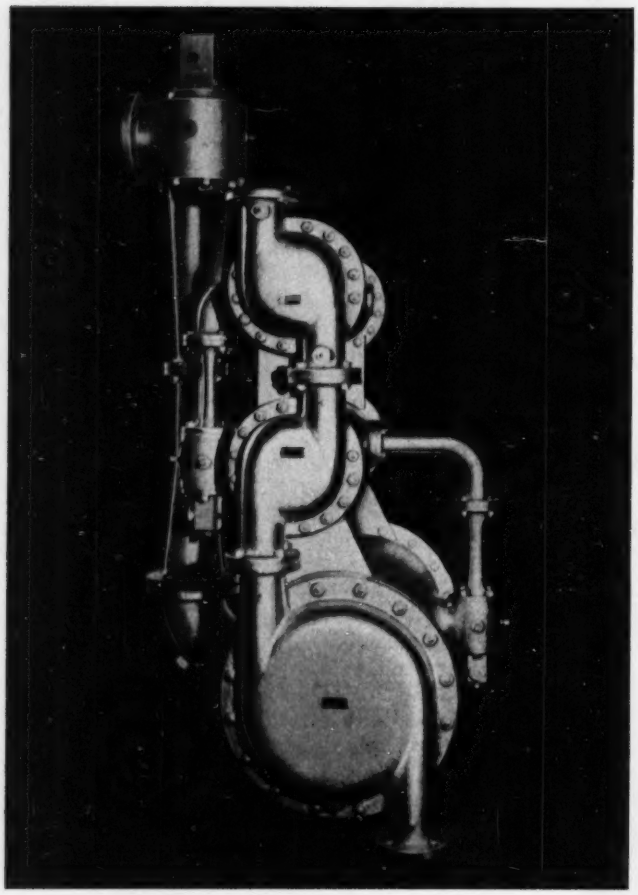
STANDARD

STANDARD OIL COMPANY
(Indiana)

ELLIOTT three-stage ejector with a double purpose...

1 **To pull the vacuum required in processing a chemical product—**

2 **To recover a valuable solvent used in the process, and return it for further use.**



For meeting the last requirement, this unit has surface-type intercondensers, as well as an aftercondenser which recovers the solvent from the exhaust of the final stage. The set-up is enough out of the usual to call for the experienced skill of Elliott specialists in developing the unit in all its details, insuring thoroughly satisfactory performance with maximum economy. As the photo shows, the assembly is neat and compact, requiring surprisingly little space for the work it does. Furthermore, as with all Elliott ejector installations, it can be installed almost anywhere with little consideration for the convenience of maintenance, since it has no moving parts and nothing to wear.

Why not utilize the experience of Elliott vacuum engineers in your next problem? Talking it over implies no obligation. For general information, ask your local Elliott field engineer for a bulletin describing the ejector you need, or write Elliott Company, Industrial Process Division, Jeannette, Pa.

ELLIOTT Company

G4-1

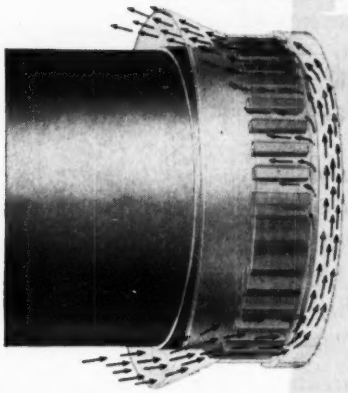


TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

Two Ways

You Can Reduce Operating Costs on Rotary Kilns...

Install an Air-Cooled Kiln End



No improvement you can make can cut your costs so much! Operating records show that an Air-Cooled discharge end will *pay for itself in 2 to 3 years* in refractory savings alone.

An Air-Cooled end circulates cooling air around the outside of discharge end and on underside of nose brick. Your kiln end stays cool, round and rigid — no warpage or end distortion.

You eliminate shutdowns required to replace end brick . . . gain valuable production time. Big fuel savings too — because Air-Cooled kiln end permits the use of a positive seal between firing hood and kiln.

. . . and an Air-Quenching Cooler



Save on fuel costs! Save on installation costs! Save on power, maintenance and clinker grinding costs!

Air-Quenching cooler captures hottest air from cooling clinker at feed end. Movable baffle in the housing directs this hot secondary air directly to kiln. Clinker is cooled by a direct up-blast of cooling air. Fuel costs are sharply reduced.

Be sure to get your copy of new cooler bulletin, 07B7869. It shows how to figure how much an Air-Quenching cooler will save for you. Get it from the A-C representative in your area or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4381

ALLIS-CHALMERS

Sales Offices in Principal Cities in the U. S. A. Distributors Throughout the World.



Kilns, Coolers, Dryers



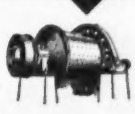
Hammermills



Jaw Crushers



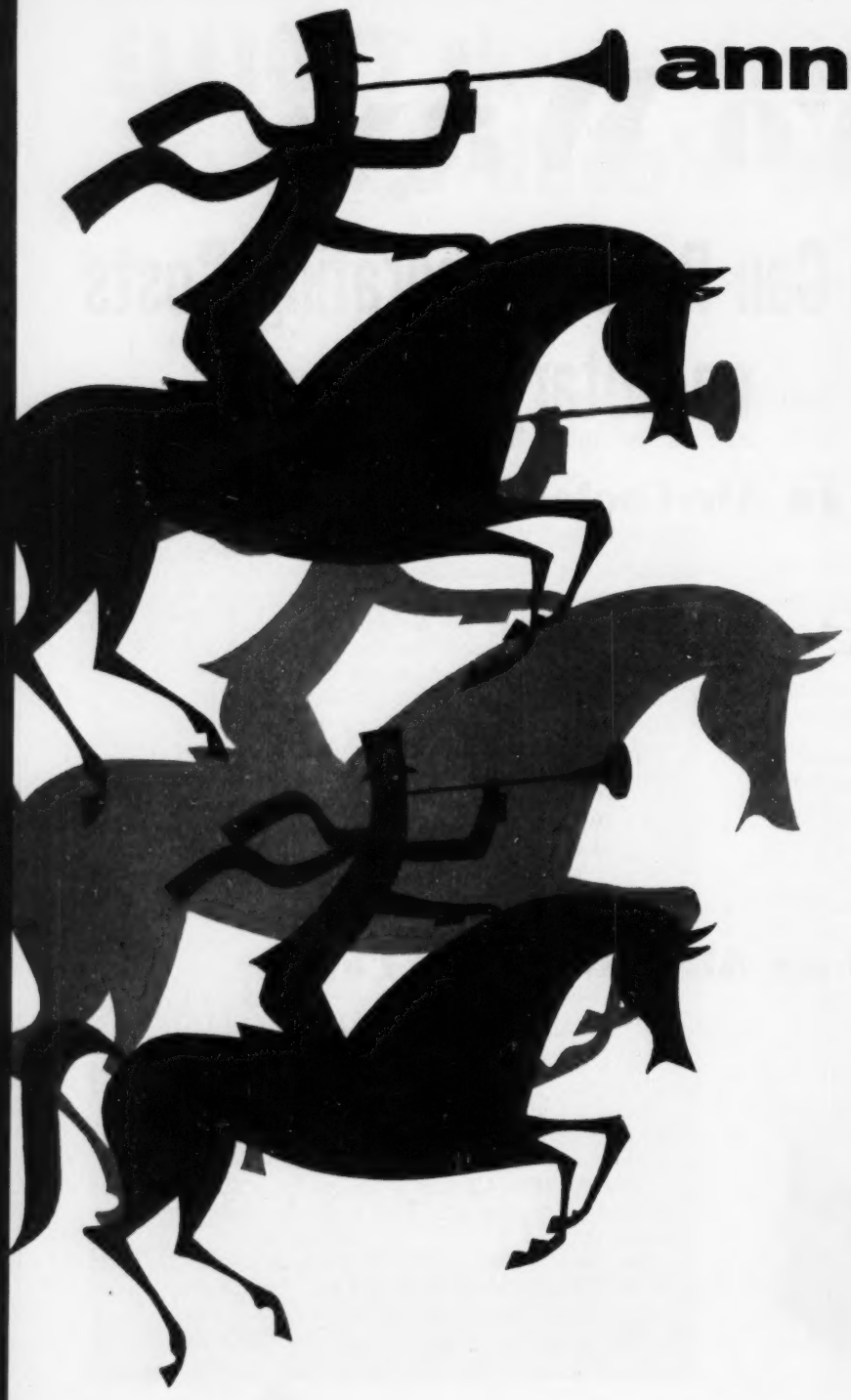
Gyratory Crushers



Grinding Mills



Vibrating Screens



announcing

. . . a change in name to keep in step with our continued expansion of facilities and services.

THE
COOPER ALLOY
FOUNDRY CO.

pioneering producer of stainless steel products—castings, jet aircraft engine rings, valves, fittings and accessories—will henceforth be known as

COOPER ALLOY
CORPORATION

For the past thirty years we have been in the forefront of developments in the high alloy industry. New materials such as gall and corrosion resistant V2B; new methods such as shell molding and advanced techniques for producing jet engine rings; new products such as the patented Quikupl fitting; plus a long list of improvements in patternmaking, coremaking, and general foundry methods, as well as leadership in the stainless steel valve and fittings field, have made it advisable to change our name and to provide individual identity for each of the following divisions:

Foundry Products Division
Stainless steel sand, shell mold and centrifugal castings

Valve & Fitting Division
Stainless steel valves, fittings, and accessories

Aircraft Products Division
Stainless steel rings for military aircraft

Stainless Engineering and Machine Works Division
Production machining of stainless steel components

COOPER ALLOY
CORPORATION • HILLSIDE, N. J.

Ansul

is the only dry chemical fire extinguisher backed by a five year warranty!

Here is proof of Ansul's superiority . . . *a five year equipment warranty*, the only one of its kind in the fire control industry.

For the buyer of fire equipment this important warranty means many *extra* years of trouble-free protection plus freedom from costly and frequent maintenance checks and repairs.

The special design and construction features that make this warranty possible provide not only dependable protection but also *fast, effective* fire control. Ansul's *weather-tight* construction keeps out moisture and resists corrosion. *Patented nozzles* deliver the right kind of stream for your fire protection problem. The *sealed pressure cartridge* puts Ansul's "Plus Fifty" dry chemical to work immediately—no delay or lag. And finally *rugged construction* makes it possible for Ansul equipment to give peak performance under the toughest operating conditions.

HERE IS THE BIG TRAINING AND SERVICE PLUS OFFERED ONLY BY ANSUL!
Available without cost to all Ansul users.



Training for your personnel at your plant by Ansul specialists.



Customer training school at Marinette for your key safety personnel.



Visual aids on fire control for your safety meetings and other training.



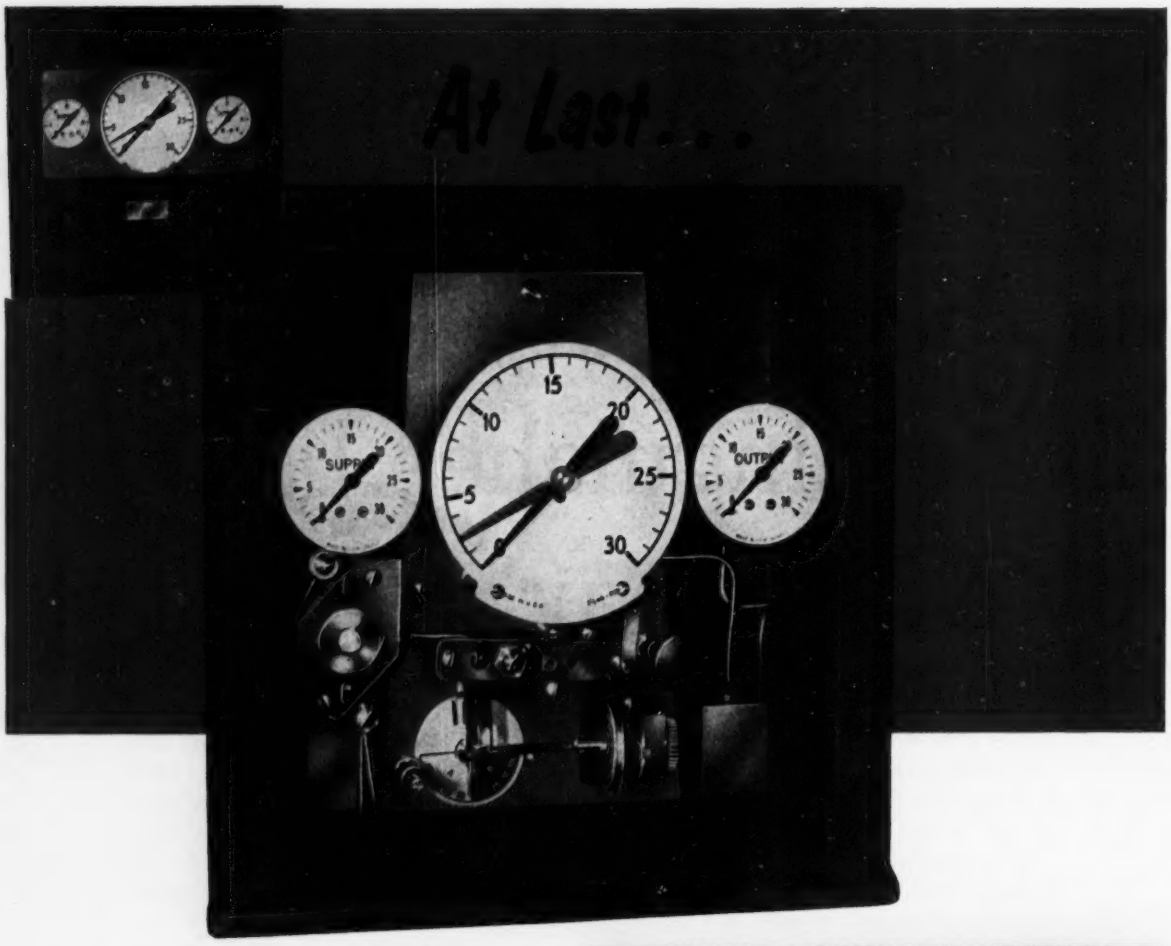
In-plant survey to scientifically determine your fire protection needs.

Call the Ansul Man!

ANSUL

Get in touch with your local Ansul man through the "yellow pages" or write ANSUL CHEMICAL COMPANY, Fire Equipment Div., Dept. F-113, Marinette, Wisconsin.





one pressure pilot that has everything the new K & M MODEL 54

Make your own comparison. In compact, self-contained design . . . in flexibility of control action, the new Model 54 Pressure Pilot is a long step ahead of the field.

No separate indicating gauge is necessary . . . controlled pressure is clearly readable on a 6¾" scale on which a red pointer shows the control point setting.

No complicated adjustments or linkage changes . . . 0 to 100% throttling range or differential gap adjustment means simply turning a dial. Only a screw driver is needed to change from direct to reverse action, throttling to snap-action differential gap control.

COMPARE PRESSURE PILOT FEATURES

Features	K&M PILOT	PILOT B	PILOT C	PILOT D
Controlled Pressure Indication	YES	NO	NO	NO
Calibrated Setting	YES	NO	NO	NO
Relay Operation	YES	YES	NO	NO
All Metal Construction	YES	NO	YES	YES
Orifice Cleaner	YES	YES	NO	NO
Feedback	YES	YES	NO	YES

And, to clean the sapphire feed orifice, no disassembly is required . . . simply press a button, that's all.

Add to these features greater stability achieved through a diaphragm feedback and a trouble-free all-metal relay. All these features contributing to control performance and simplified operation are available *without extra cost* in the new K & M Model 54 Pressure Pilot. Write for information today.

K&M

diaphragm control valves and regulators
Since 1879

64 Genung Street
Middletown, New York



CAN TYPE VERTICAL PUMP

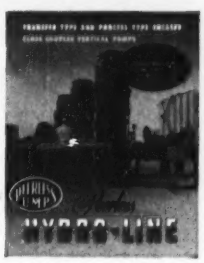
Now Available in Two Types—FOR APPLICATION to CHEMICAL PROCESSING, REFINING TECHNIQUES, CONDENSATE SERVICE, AND LINE BOOSTER SERVICE

NEW DESIGNS PROVIDE BOTH A PROCESS TYPE AND A TRANSFER TYPE

The process type vertical Hydro-Line pump, especially suited to refining and process pumping offers the following features—1) API-ASME code welding; 2) especially designed containers for either mechanical shaft seals or packing; 3) availability of head and barrel flanges up to 300 lbs. or more; 4) extra heavy wall thicknesses for maximum stability and high safety factor; 5) elliptical barrel bottom design for optimum fluid entrance conditions. The transfer type Hydro-Line pump is of a similar design to the process type differing in materials of construction required for less rigorous service. Both types are extremely flexible in installation, are easy to inspect, service and maintain—can be designed for operation on any available system NPSH. Write for new Bulletin No B-1700.

THE PEERLESS
HYDRO-LINE
ENCASED CLOSE-COUPLED PUMP

CAPACITIES TO	3000 gpm
HEADS TO	1000 feet
DRIVES	As required, vertical solid shaft, or explosion-proof motors; steam turbine.
TEMPERATURES	Up to 400° F.



PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

Factories at: Los Angeles, Calif., and Indianapolis, Ind. *Offices:* New York; Atlanta; Chicago; St. Louis; Indianapolis; Phoenix; Fresno; Los Angeles; Dallas, Plainview and Lubbock, Texas; Albuquerque, New Mexico.

Distributors in Principal Cities; Consult your Telephone Directory.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send me a copy of Peerless Hydro-Line Pump Bulletin No. B-1700.

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ADDRESS _____

TOWN _____ STATE _____

6 STAR FEATURES

WHO SAID THERE'S NOTHING NEW IN CENTRIFUGAL PUMPS



B & G SERIES 1510 TYPE B CENTRIFUGAL PUMP

Years ahead! A VERTICAL split case pump with balanced loading of impeller and bearings...capable of handling loads far in excess of those produced by any pump and motor combination! Easily serviced without breaking pipe connections!

1. **Solid-type Volute with Support Foot.** Can be left in pipe line when servicing pump—rugged construction absorbs piping strains.
2. **Removable Bearing Frame.** Complete bearing frame, including seal and impeller, can be removed without disturbing piping or motor leads. The bearing frame is replaceable and interchangeable on all sizes.
3. **Leak-proof Mechanical Seal.** Features the exclusive, harder-than-glass B&G "Remite" insert. This Seal Construction has enabled nearly two million B&G Pumps to make an amazing record for failure-proof performance.
4. **Hydraulically Balanced Impeller.** Balancing chamber and pressure relief holes in the impeller reduce thrust to a minimum, lengthening pump life.
5. **Anti-Friction Roller Bearings.** Timken Bearings handle thrust and radial loads for smoother, quieter, more efficient operation.
6. **Oil Lubrication.** No messy, undependable grease cups—circulating oil lubrication assures positive protection to bearings. Oil level indicator permits visual check.

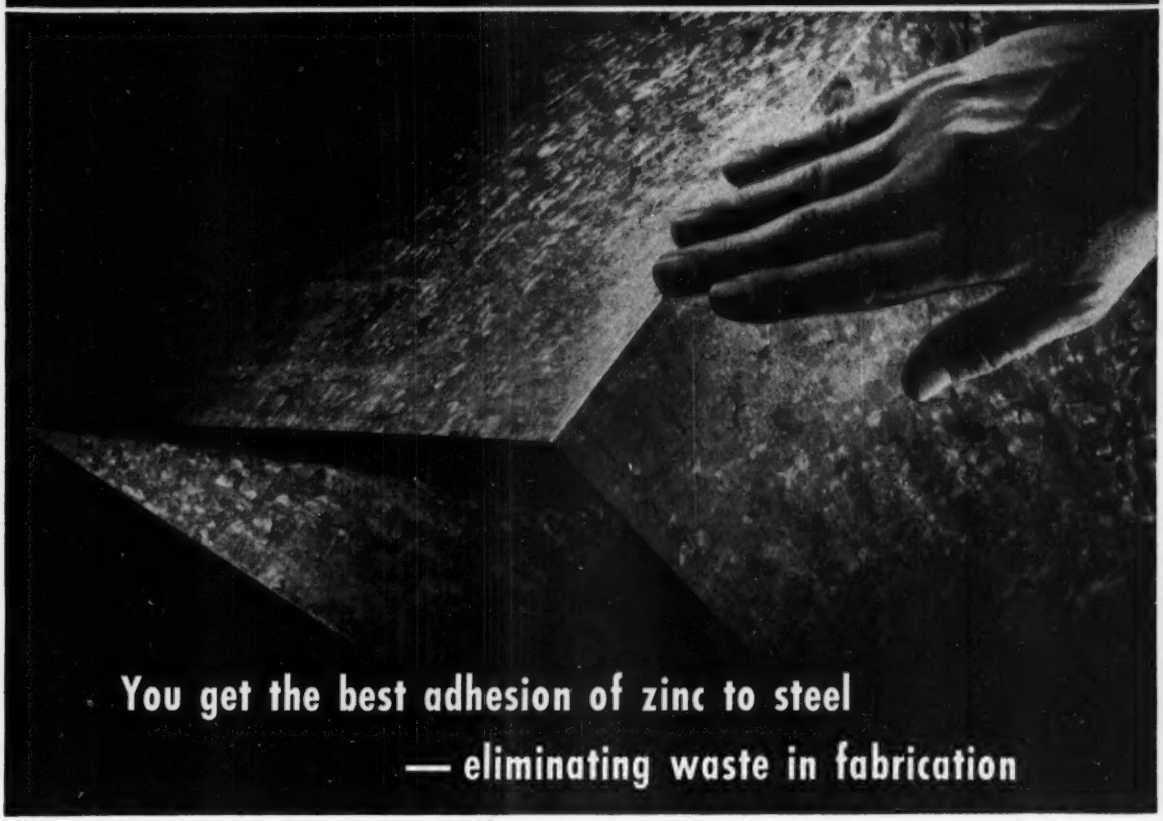
SEND TODAY FOR SIZE AND CAPACITY DATA

BELL & GOSSETT COMPANY

Dept. DP-14, Morton Grove, Illinois

Canadian License: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

WHY IT PAYS TO BUY GALVANIZED SHEETS FROM US



You get the best adhesion of zinc to steel — eliminating waste in fabrication

• USS Galvanized Steel Sheets are noted for their unusually tight protective coating of zinc that effectively resists cracking and flaking under tough fabricating operations—bending, rolling, cutting, stamping, soldering. This means a faster, better fabricating job. And these sheets are consistently uniform in ductility, flatness and surface finish.

USS Galvanized Sheets – as well as *all* the steel sheets and strip that we sell—are the well-known, always reliable products of United States Steel . . . the world's foremost manufacturer of fine steels.

Whatever your requirements for sheets or strip, of any type, it will pay to call U.S. Steel Supply. You will get fast delivery of exactly what you need from our complete stocks. In addition, we are staffed to give qualified technical asistance in helping you solve difficult application problems. And, for cutting or shearing your sheets to size, our modern equipment means closer tolerances, less scrap loss.

In addition to USS Galvanized Steel Sheets, call us for: hot rolled, cold rolled, Vitrenamel, galvannealed, paint bond, corrugated, and long terne sheets, and hot rolled and cold rolled strip.

TRIPLE SECURITY

What you want
When you want it
At the right price

U. S. STEEL SUPPLY
DIVISION

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208 So. La Salle St., Chicago 4, Ill.

USS

Warehouses and Sales Offices Coast to Coast

USS STEEL UNITED STATES STEEL

UNITED STATES STEEL



New G-B

SNAP*ON

PIPE INSULATION

SIZES?

Large or small, we have them ALL!

Good news! G-B Snap*On Pipe Insulation is now available in a complete range of sizes and thicknesses for piping from ¾" to 24" in diameter. It is also available plain or with factory-applied vapor barrier facing. Now you can insulate hot and cold pipe of all sizes with this unique one-piece insulation molded of feather-light glass fibers!

"One-piece". . ."feather-light"—just picture what these characteristics mean in **savings.** They mean that one man can easily carry complete sections to the job . . . quickly snap them over pipe . . . quickly secure them with staples . . . easily paint or finish them as desired.

And due to the outstanding thermal efficiency of G-B Snap*On (K factor of .23 at 100° F. mean) you enjoy an important "second saving." For any given wall thickness, G-B Snap*On prevents more heat or cold loss than any pipe insulation on the market. Or to look at it another way, now you can use pipe insulation of thinner wall dimensions than you ordinarily use—and still achieve, or improve, thermal efficiency.

Seeing is believing—write today for samples and new 8-page brochure with complete descriptive and technical data.

gb

GUSTIN-BACON MANUFACTURING CO.

252 W. 10th STREET KANSAS CITY, MISSOURI



SAVE 3 WAYS
With Stainless Steel Containers

You save 3 ways by shipping chemicals in stainless steel containers. First, there isn't the chance of loss by damage in shipment that there is with breakable carboys. The danger of breakage is all but eliminated.

Then, delivered cost per pound or gallon of your chemicals is less because stainless containers are relatively light. Finally there is a big saving in lumber, carpenter's time and general loading costs because stainless containers can be loaded in freight cars with a minimum of bracing.

Stainless steel shipping containers are obtainable in a wide range of capacities and in stainless analyses to suit requirements. For a listing of chemicals shipped and handled in stainless, and names of container manufacturers who use Armco Stainless Steels, just fill out the attached coupon and mail it to us.

ARMCO STEEL CORPORATION
4754 Curtis Street, Middletown, Ohio

☐ Tell me where I can obtain Armco Stainless Steel containers.
☐ Send me a listing of chemicals shipped in stainless containers.

NAME_____

FIRM_____

STREET_____

CITY_____ ZONE____ STATE_____

ARMCO STEEL CORPORATION
4754 Curtis Street, Middletown, Ohio

ARMCO®

SHEFFIELD STEEL • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

Dirty Water can't "Shut-down"...

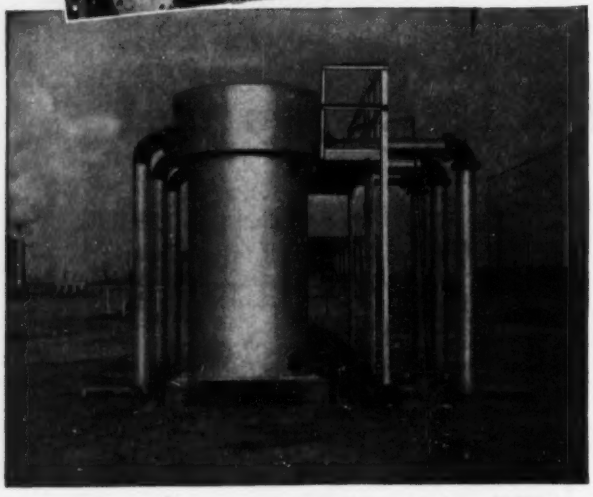
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler*

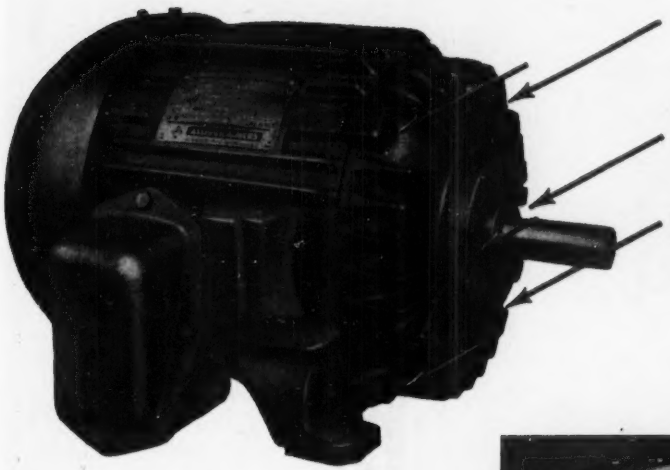
BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Here's motor superiority
you can see

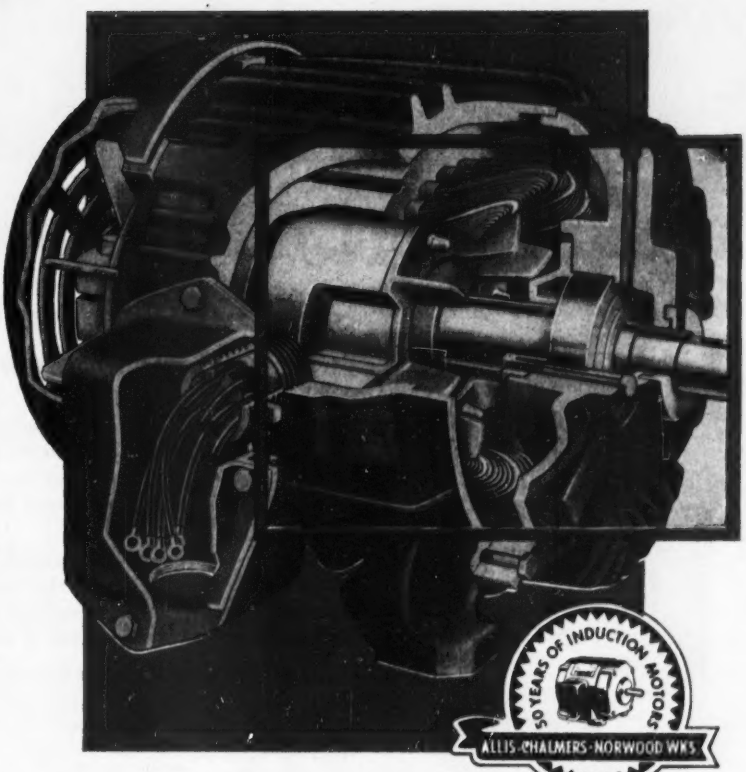


It takes 6 bolts not just 4 to give full bearing protection

THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of *extra* protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.



Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

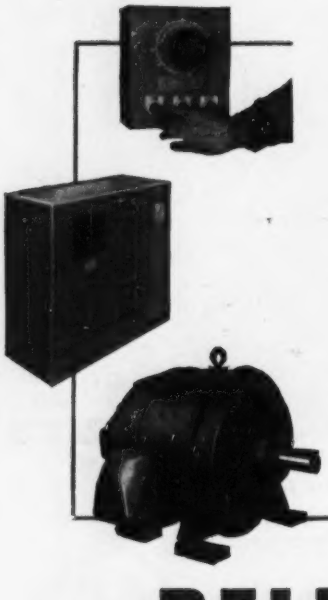
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-4441



ALL-ELECTRIC ADJUSTABLE-SPEED DRIVE



provides Automatic Load Control for safe, high-speed pulp grinding

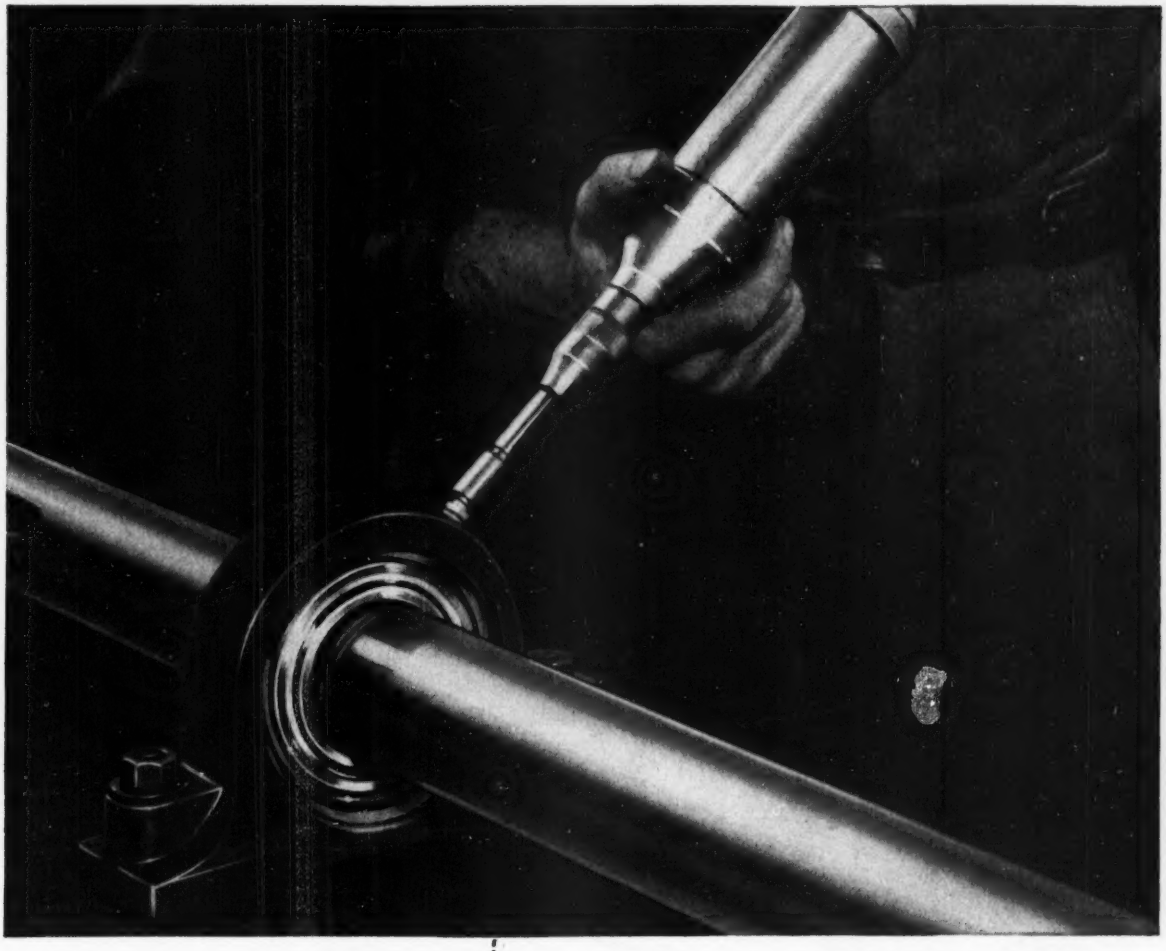
This pulp grinder operates at high speed for maximum pulp production without any worry about overloading. The team made up of Reliance V★S Drives and electronic regulators protects the grinder from overload yet keeps pulp production at the highest safe level.

Fully automatic regulation controls the production of pulp within the limits of the grinder. The Reliance V★S Drive slows down the feed ring before overloading occurs, yet acceleration is fast and smooth when the grinder is ready for more logs.

The advantages of Reliance motors, adjustable-speed drives, controls and regulators, and applied engineering are quickly available to users and manufacturers of machinery. For more information, write for Bulletin D-2311 or contact your nearest Reliance Sales Office. D-1485-A

RELIANCE ELECTRIC AND ENGINEERING CO.

1063 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*



NO, SIR! The Seal Won't Blow!

METALLIC-BACKED neoprene seals are used in this famous bearing—and they are engineered to *stay put.* They won't blow.

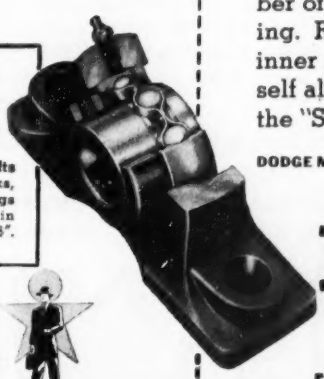
Your lubricant stays in; dust and dirt stay out; the result is years of trouble-free performance.

The "SC" Bearing is a service-proved member of the Dodge 30,000 hour line. Modern styling. Rugged one-piece cast-iron housing. Long inner race. Radial and thrust load capacity. Fully self aligning. *WRITE* for complete information on the "SC" Bearing in the Dodge catalog.

DODGE MANUFACTURING CORPORATION, 200 Union St., Mishawaka, Ind.

DODGE TYPE "SC" BALL BEARING PILLOW BLOCK

Precision built bearing for small shafts and moderate loads. Pillow blocks, flange bearings and hanger bearings available from distributors' stocks in shaft sizes ranging from 3/4" to 2-7/16".



CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained, he can give you valuable assistance on new, cost saving methods. Look for his name under "Power Transmission Equipment" in your classified telephone book.

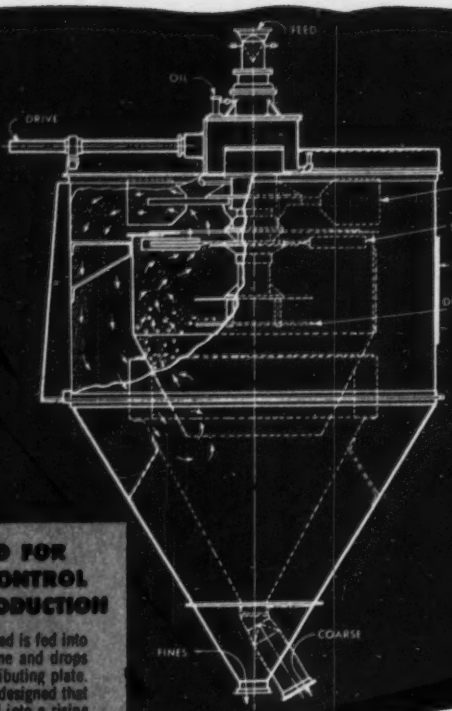
DODGE

of Mishawaka, Ind.

FIRST IN POWER TRANSMISSION MACHINERY

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS



More Accurate Sizing Of Ground And Pulverized Materials!

ENGINEERED FOR PRECISION CONTROL AND HIGH PRODUCTION

Material to be classified is fed into the top of the machine and drops onto a revolving distributing plate. This distributor is so designed that it sprays the material into a rising air current which entirely surrounds the plate. The finer particles are lifted by the air stream and the coarse particles drop down to the rejects spout. Passing up through the separating chamber, the dust-laden air is given a whirling motion between Spinner blades and any remaining oversize particles are precipitated. The separator is adjustable to control the fineness of the finished product with unusual accuracy.

WILLIAMS MECHANICAL AIR SEPARATORS

For Finenesses From 30 to 325 Mesh

- Most efficient mechanical air separator ever developed for classifying ground and pulverized materials, or for removing fines from dry ground materials before classifying.
- Product quality is vastly improved and output considerably increased when operated in closed circuit with virtually any type of mill.
- Will handle with equal efficiency a complete range of products—mineral, chemical and vegetable—from the hardest, most dense limestone and ore to the softest, fluffiest starches and flours.
- Permits coarser settings in grinding equipment thus lengthening equipment life by reducing wear on all moving parts. Power consumption is much lower.
- Extra heavy construction. Equipped with anti-friction bearings encased in dust-proof and moisture-proof housings. All casings are of heavy steel plate construction. Operation is dustless and repair cost is practically nil, since there are no fine sieves to wear out and the heavy construction insures long life.

9 Standard sizes, 2½ to 18-foot diameters — Capacities from 500 lbs. to 75 tons hourly



18-Foot Williams RC Separator being tested at plant before shipment.

Write For Details And Describe Your Operation

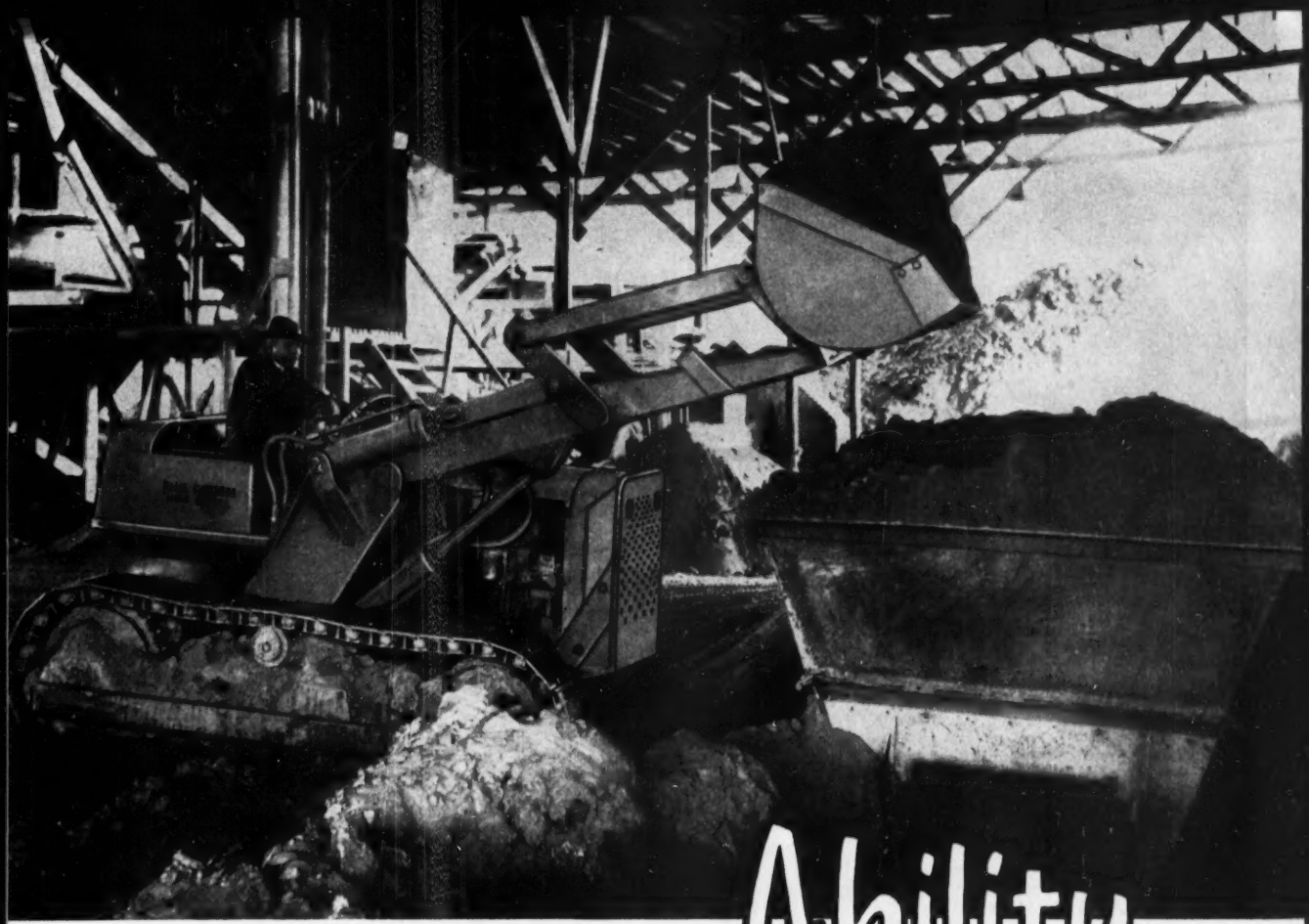
WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 NORTH NINTH • ST. LOUIS 6, MO.

WILLIAMS

CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



can you match this Ability with any one machine?

Ability to dig The Allis-Chalmers HD-5G Tractor Shovel is not merely a loader. It is a powerful excavator. It can dig into clay, break up and load hard-packed bulk chemicals. Bucket teeth and rear-mounted hydraulic ripper attachments are available to speed tough excavating jobs.

Ability to load fast With its big 1¼-cu-yd bucket — and the power to crowd it full — the HD-5G keeps loading and stockpiling jobs moving at peak production. Two-yard light materials bucket is available for snow, coal, and other light materials.

Ability to maneuver—in close quarters. It takes a crawler tractor to utilize such power and capacity in such a small space. The HD-5G pivots around within its own track length. Special high-speed reverse adds further to output on short-cycle jobs.

Ability to handle any load A wide variety of front-end attachments may be quickly interchanged with the standard bucket. Included are Lift Fork for packaged and palletized loads, Bulldozer for stripping and stockpiling, Crane Hooks for machinery and other heavy, solid objects, special Rock Buckets and Rock Forks. Drawbar is always available for heavy hauling jobs.

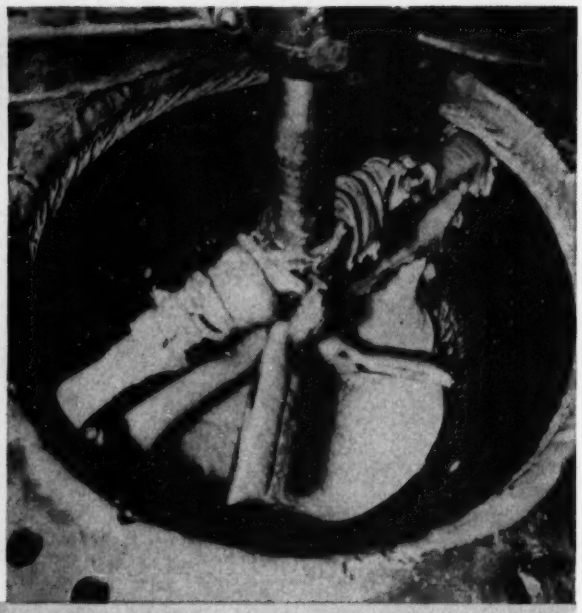
Ability to work anywhere any time The HD-5G has stability to work safely over rutted or uneven ground . . . traction and flotation to travel through snow, mud, sand where rubber-tired equipment cannot operate. It is the ideal machine both for materials handling and yard maintenance jobs.

Write for literature or ask your Allis-Chalmers dealer to tell you more about the versatility and flexibility of the HD-5G. Let him show you how its ability to switch from job to job — and to do each one well —can save you time, labor and specialized equipment.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

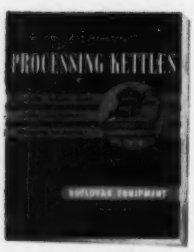


Heavy film on heating surface retards heat transfer, slows production—when no scraper blades are used.



Clean heating surface improves heat transfer, speeds production—when film has been completely removed by *Buflovak-Dopp* Scrapers.

Buflovak-Dopp Kettles with scraping agitator speed production... make a better product... save money



Write for your copy of Catalog 356-R, which contains much useful information about processing kettles.

The effectiveness of *Buflovak-Dopp* Scrapers, used in *Buflovak-Dopp* Kettles, is clearly indicated in the photographs. The results are savings up to 80% in production time on some products . . . attractive profit-building savings when processing *any* material.

Clean heating surfaces accelerate heat transfer and are therefore most important for efficient processing. For example, a stagnant film of paraffin only a hundredth of an inch thick has the same heat retarding action as a wall of cast iron 180 times thicker.

When pasty materials are being cooled, *Buflovak-Dopp* Scrapers constantly remove the stagnant material from the kettle wall . . . and move it to the center of the mass in the kettle for uniform mixing. The result is a uniform, good quality finished product.

When processing heat-sensitive materials, these continuous action scrapers protect the good quality of the product by preventing material from burning on the heating surface.

But these are only two typical examples of the effectiveness of *Buflovak-Dopp* Kettles equipped with *Buflovak-Dopp* Scrapers. To get the type of kettle and scraper that will meet your needs, the safest procedure is to process a quantity of the product and observe the results. The Pilot Plant in our Research and Testing Laboratory provides facilities for you to run such tests.

With this basic information, kettles can then be designed and built to most economically and profitably fulfill your specific processing requirements.

BUFLOVAK EQUIPMENT DIVISION
BLAW-KNOX COMPANY
1551 Fillmore Avenue, Buffalo 11, New York

BLAW-KNOX

BUFLOVAK PRODUCTS: evaporators • dryers (atmospheric and vacuum) • solvent recovery and distillation equipment • chemical plant equipment • food processing equipment • kettles • fabricated processing equipment • vulcanizers . . . plus a complete Pilot Plant for pre-testing processes and products.

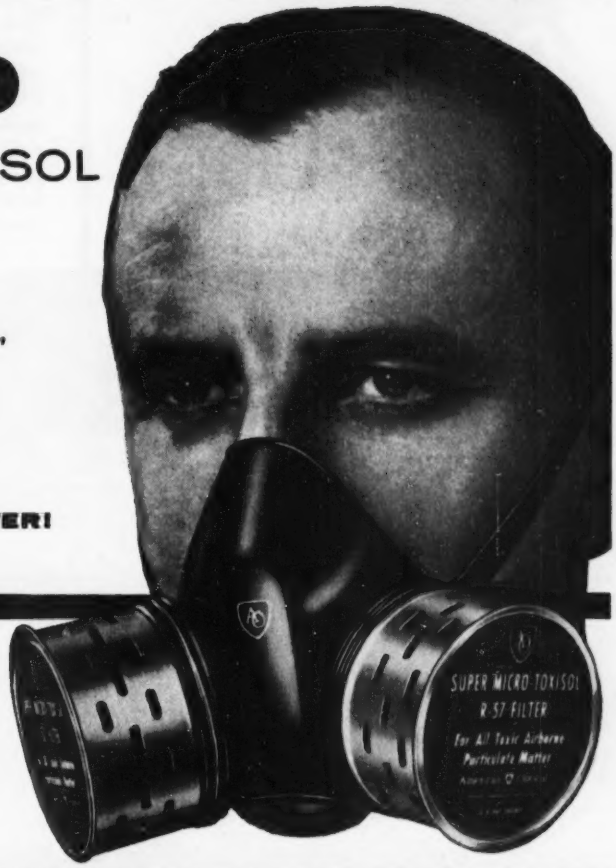


Respiratory Protection

NEW...AO
SUPER MICRO-TOXISOL
FILTER R57

Protects Against Dusts, Mists, Fumes, Significantly More Toxic than Lead — including

RADIOACTIVE PARTICULATE MATTER!





99.99% Filtering Efficiency against particles 0.3 micron in size!

With R57 Filters, an AO R5057 Respirator protects against *0.3 micron particles* with a filtering efficiency *greater than 99.99%*. Particles of this size are the most difficult to filter because the effect of the various forces of deposition are minimum at this size. In the R5057 Respirator there are over 90 square inches of filtering area, providing both a low resistance to inhalation and a long service life.

This respirator protects against *all* toxic air-borne particulate matter significantly more toxic than lead, *including radioactive dusts, mists, fumes, and most types of bacteria.* With this filter, protection against aerosols containing compounds of beryllium, selenium, arsenic, thallium, uranium, cadmium, radium, palladium, thorium, phosphorus, and chromium is assured.

AO's R5000 Respirator Series includes 9 interchangeable combinations which offer protection against many different hazards:

1. *With R50 filters* — protection against all dusts (not significantly more toxic than lead) (Bureau of Mines Approval 2156).
2. *With R50A prefilters and R50 filters* — protection against pneumoconiosis-producing mists, chromic acid mists, and all dusts (not significantly more toxic than lead) (Bureau of Mines Approval 2156).
3. *With R51 cartridges* — protection against organic vapors and gases (Bureau of Mines Approval 2304).
4. *With R52 cartridges* — protection against acid gases.
5. *With R53 cartridges* — protection against organic vapors and gases, and acid gases.
6. *With R54 cartridges* — protection against ammonia and other alkali gases.
7. *With R55 cartridges* — protection against all dusts (not significantly more toxic than lead) and organic vapors and gases. (Bureau of Mines Approval 2305).
8. *With R56 filters* — protection against fumes (not significantly more toxic than lead). (Bureau of Mines Approval 2163).
9. *With R57 filters* — protection against all toxic air-borne particulate matter in the form of dusts, mists, or fumes. There's no better protection.

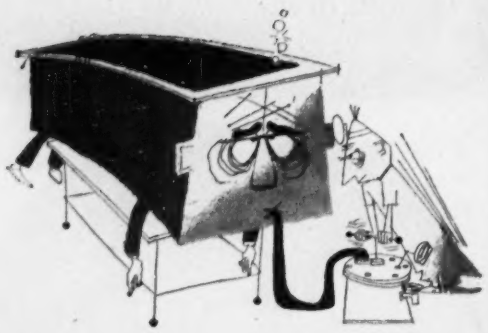
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AO SAFETY ZONE

Keep your workers in the Safety Zone with American Optical Safety Equipment

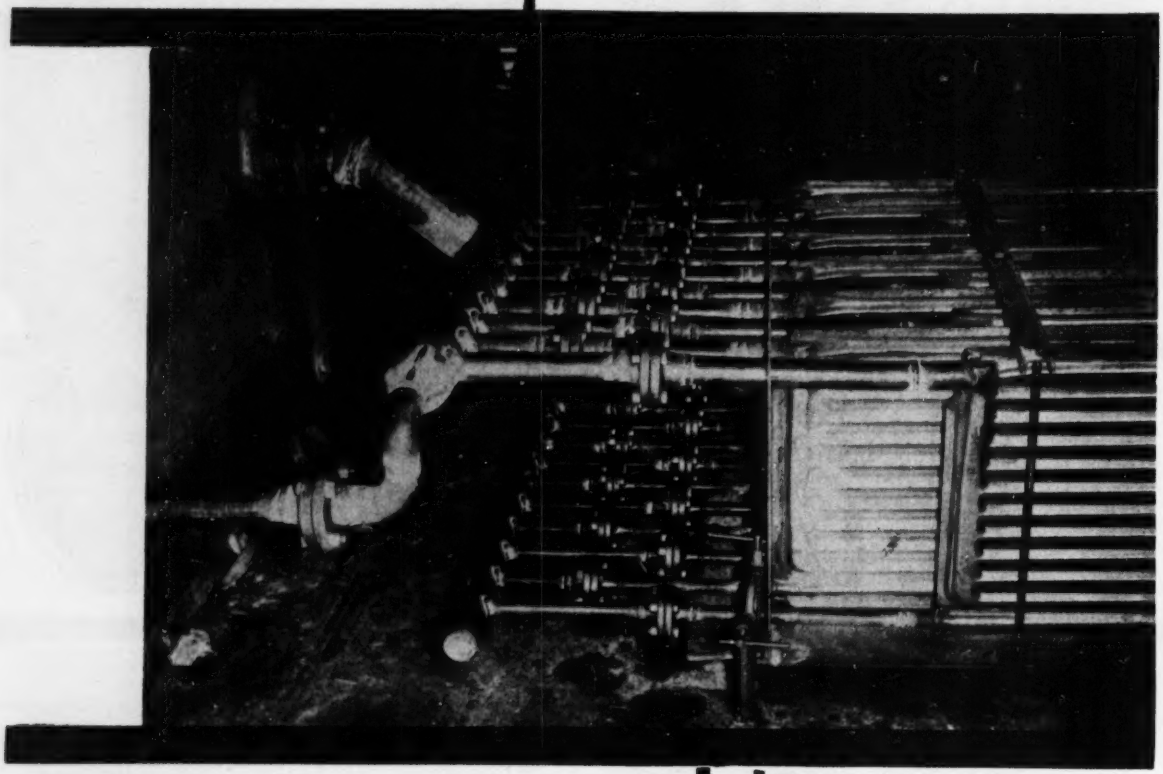
Your nearest American Optical Safety Products Representative can supply you

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES



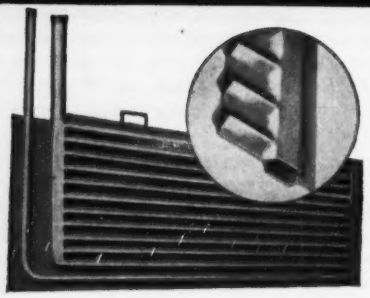
steam costs cut 96% as PLATECOILS cure coil-itis *

Old Colony Tar Company cut their steam costs 96% and saved a full week heat-up time per removal by replacing pipe coils with Platecoils in their tar storage tanks. It took a week for the pipe coils to heat a 250,000 gallon tank to pumping temperature . . . now, with the Platecoils, there is no heat-up time required. It cost $100.00 per removal for steam . . . now steam costs have been cut to $4.00 per removal, and $96.00 is saved. This installation is described in detail in Bulletin P61 shown below.

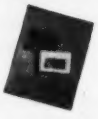


PLATECOILS replace pipe coils for 50% of the cost

* Coil-itis is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference as Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old fashioned and outmoded pipe coils.



Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.



Platecoil Division, TRANTER MANUFACTURING, Inc., Lansing 4, Michigan

For fast shipment see your local distributor

What do you want in the welded stainless tubing you use?



Perhaps your biggest headache is corrosion. Maybe it's oxidation, or contamination, workability, or some combination of these. Whatever it is, the solution lies in getting the *right* welded stainless tubing for your particular operation.

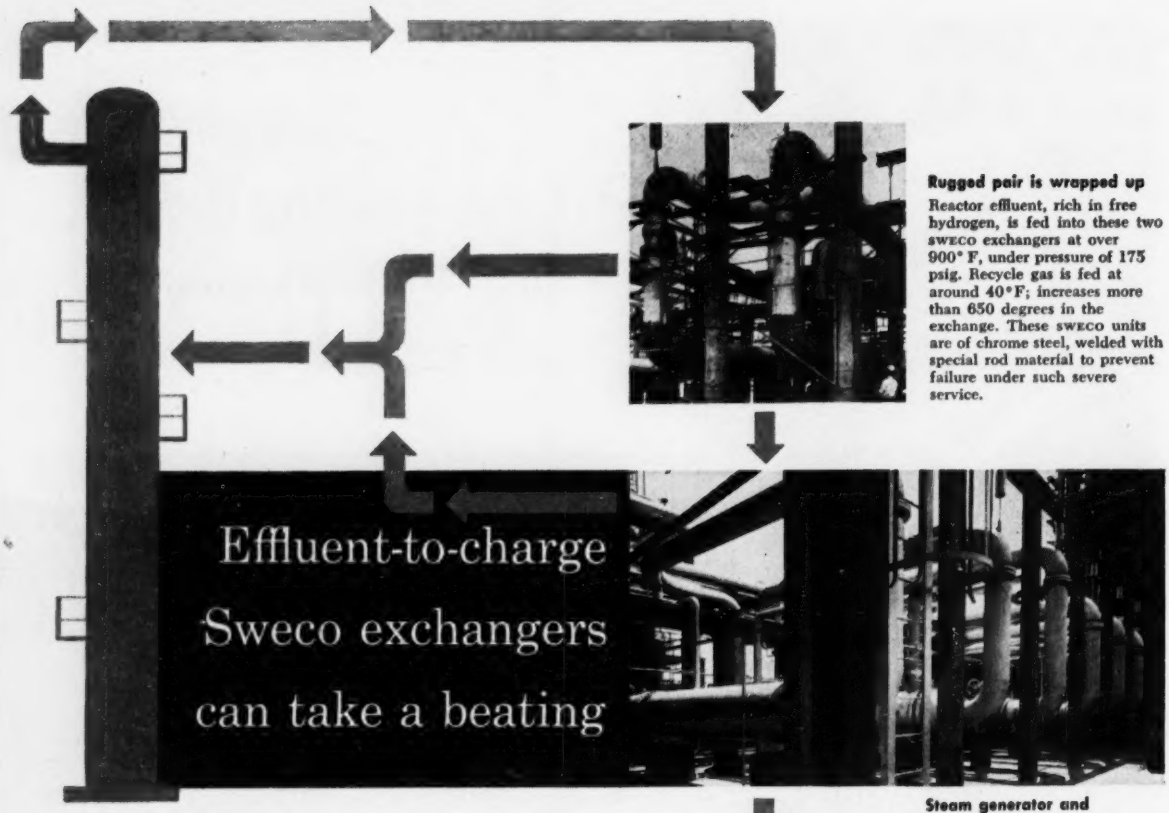
With B&W welded stainless tubing you can be sure you are getting not only the right grade of stainless steel but also tubing with the properties you desire for easy fabrication and long service life.

Put your stainless tubing problems up to Mr. Tubes, your link to B&W, who represents the B&W Headquarters Technical Staff, Regional Sales Offices, and a cross-country network of experienced tubing distributors. You can have confidence in his suggestions, based on broad and intimate experience with stainless applications, to help you make the right choice for your requirements.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-4033 (SWP)



Effluent-to-charge Sweco exchangers can take a beating

Rugged pair is wrapped up

Reactor effluent, rich in free hydrogen, is fed into these two SWECO exchangers at over 900° F, under pressure of 175 psig. Recycle gas is fed at around 40°F; increases more than 650 degrees in the exchange. These SWECO units are of chrome steel, welded with special rod material to prevent failure under such severe service.

Steam generator and Naphtha feed

Steam is generated in two of these SWECO exchangers; in the other four, the naphtha charge to the reactor picks up more than 400 degrees of heat from the effluent.

Sweco condensers finish the job

Final stage in the heat-transfer is accomplished in this bank of four SWECO condensing units. (The effluent loses a total of nearly 800 degrees in passing through the SWECO exchangers in these illustrations.)

It's a tough assignment for a heat exchanger to transfer nearly 225,000,000 BTU over a temperature range of 800°. A SWECO exchanger train, consisting of 12 shells, is doing it in the new Thermofor Catalytic Reformer (TCR) at General Petroleum Corporation's Torrance refinery.

To withstand the wide variation in temperatures in the first stage of heat transfer, SWECO engineered and fabricated exchangers of special high-temperature chrome steel . . . *using welding rod producing metal of identical analysis to the parent metal.* This required precise pre-heat and post-heat treatment of the entire unit during the welding operation.

Fine shop equipment—years of experience in fabricating steel and special alloys—personal follow-through to meet customers' exact requirements and time schedules—all combine to make SWECO a dependable source for engineering and manufacturing process equipment, *no matter how tough the assignment.*

Send for bulletin showing standard SWECO exchangers . . . and giving details of our engineering and manufacturing services.

GET A SWECO PROPOSAL ON YOUR NEXT JOB

SWECO

Southwestern Engineering Corporation

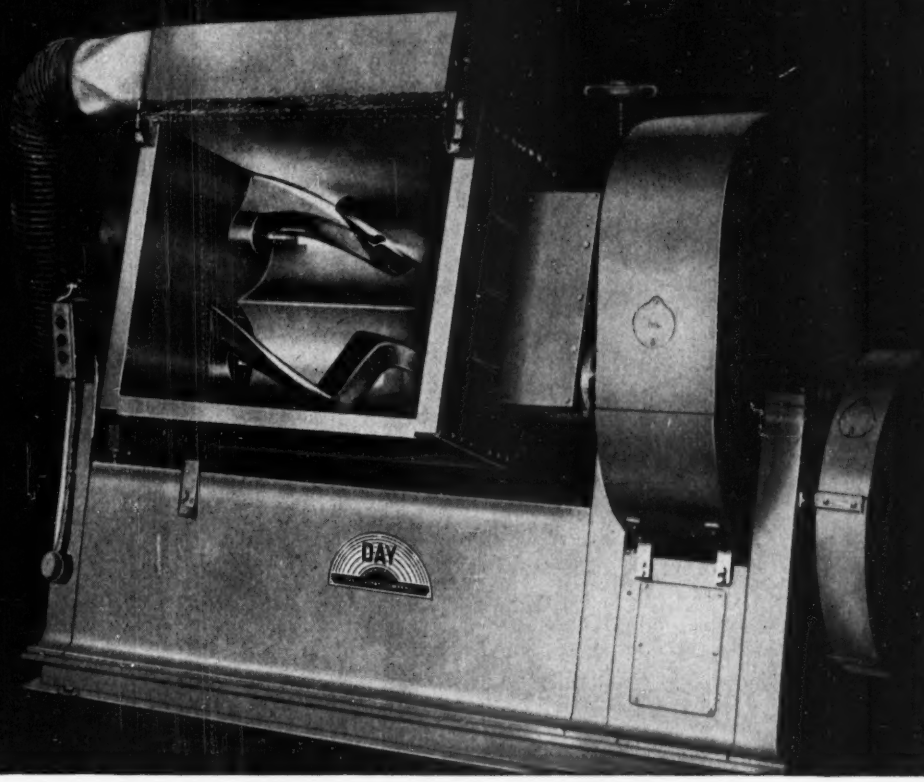
Engineers and Constructors . . . Manufacturers Serving the process industries

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Los Angeles 58, Calif. Dept. CE-104
JEfferson 7131
Cable Address: SWECOLA

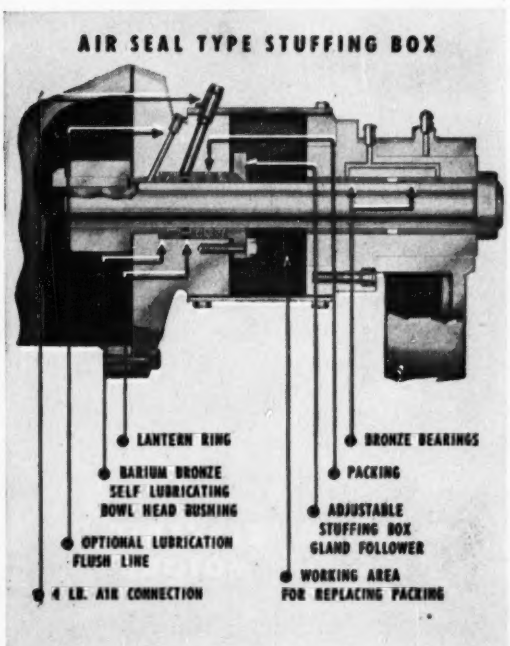
SWECO PRODUCTS

Heat Exchangers
Custom fabrication of all types of steel and special alloy vessels for the process industries.
Screen Separators.

DAY means longer life span



DAY Imperial Mixer installed at Woodall Industries, Detroit, Mich.



✻ **Built for heavy duty, engineered for precision . . . this combination makes DAY's Imperial Mixer extra long-lasting and serviceable. It has been re-engineered with major advances in design, assuring fast, thorough dispersion mixing of heavy plastics and colors in paints and inks, as well as sludge reclamation in paints and enamels.**

Shown at left is one of the Imperial Mixer's most valuable features . . . the Air Seal Type Stuffing Box. Pneumatic pressure at 4-10 lbs. protects your product against contamination by lubricants and guards bearings from damage by abrasive mixtures. CO_2 may be substituted for air. For details, call your nearest J. H. Day field engineer or write for Bulletin 600.

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STERLING ELECTRIC POWER DRIVES

ENGINEERED TO YOUR REQUIREMENTS

For the Best

VARIABLE SPEED



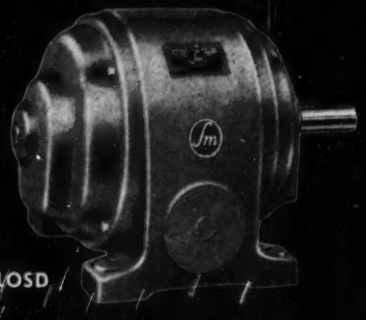
SPEED-TROL

LOW SPEED



SLO-SPEED

CONSTANT NORMAL SPEED



KLOSD



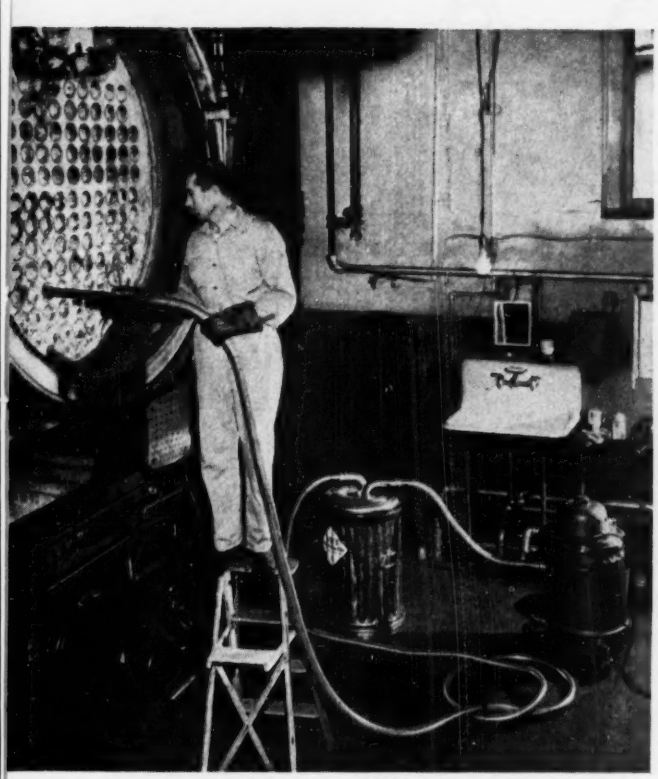
20-page illustrated catalog... Sterling Speed-Trol, Slo-Speed, Klosd and Klosd-Tite Electric Power Drives. Write for catalog No. 574.

STERLING ELECTRIC MOTORS

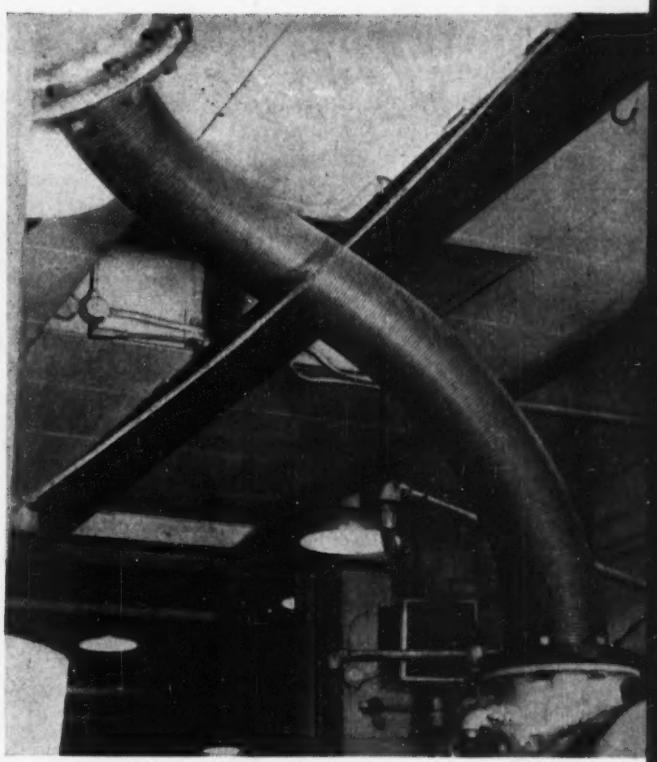
Plants: New York City 51 • Van Wert, Ohio • Los Angeles 22 • Hamilton, Canada • Santiago, Chile

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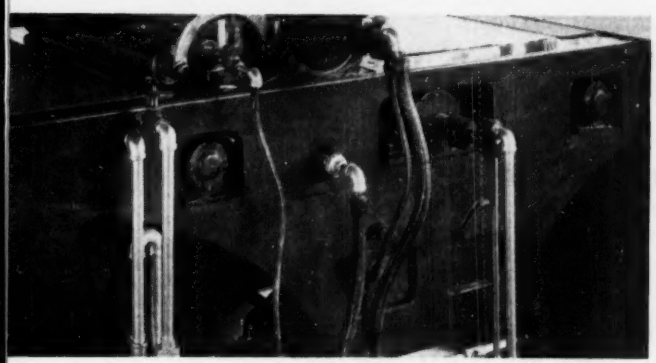
News about flexible metal hose and tubing



• • • in a chemical products plant. Empire Chemical Products Co., Newark, N. J., uses American Flexible Steel Vacuum Hose—1½ in. I.D.—to remove soot from boiler tubes. Specially designed for suction work, Type VAC is made with rubber or asbestos packing. Here, this heavy-duty metal hose is asbestos-packed. It's light, easy to handle and draw around obstacles, has a smooth exterior and is extremely flexible.



• • • in a motor car company. This length of 8 in. I.D. American Flexible Stainless Steel Vacuum Hose is packed with copper wire and fitted with special flanges. It carries away exhaust gases on diesel engine testing equipment at the Packard Motor Co., Detroit, Michigan. It's *flexible*, bends into desired position easily. And it allows for expansion and contraction caused by temperature changes up to 1500°F. in these exhaust lines.



• • • in a textile machinery company. Manufactured by the Grand Rapids Textile Machinery Co., Grand Rapids, Michigan, this "Roto Press," which is used to press garments, gets its steam through four lines of American Seamless Flexible Bronze Tubing. Two lines are ½ in. I.D.; two are ¼ in. I.D. Because American Seamless is "all-metal" it won't swell up, disintegrate or collapse under the tremendous heat of high steam pressures.



• • • on a frozen food display cabinet. The entire condensing unit on this model 390 XF Hill Frozen Food Display pulls out for quick inspection and easy repair . . . without disconnecting refrigerant lines—thanks to American Seamless Flexible Bronze Tubing. One-piece construction of this tubing eliminates the hazard of refrigerant leaks under both high and low pressures. American Seamless is strong, flexible and 100% tight.

FREE BOOKLET! Quick-reference Catalog CC-400 shows how the tubing is designed, used and installed—gives specifications on tubing and fittings. Write for your copy today. *The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Co., Ltd.*

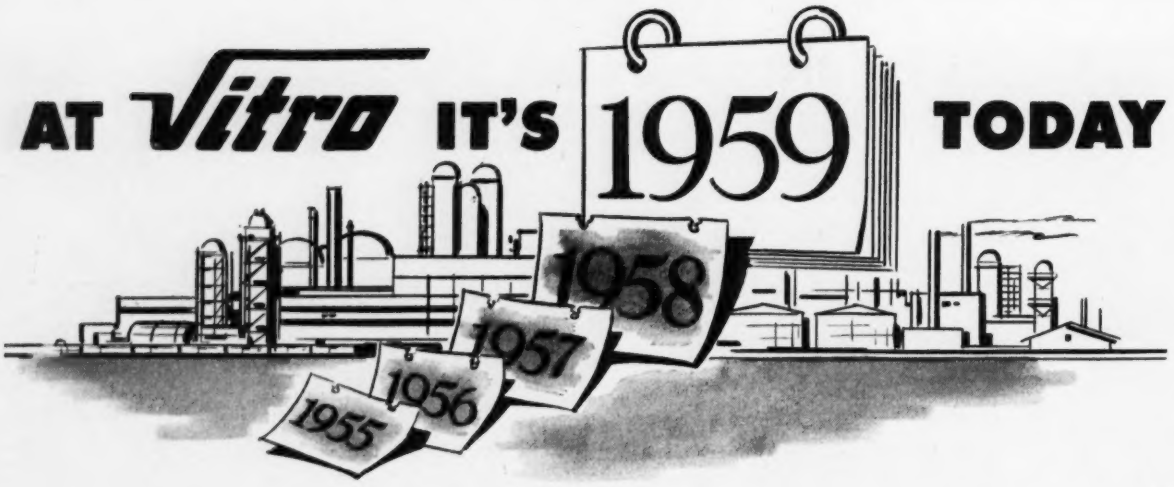
54197

WHEREVER CONNECTORS MUST MOVE

AMERICAN

flexible metal hose and tubing—an ANACONDA® product

AT Vitro IT'S 1959 TODAY



It's not enough to keep up with the times. Your success today depends upon keeping ahead of competition.

At VITRO the desk calendars may read 1954, but the mental calendars are turned to 1959

By consistently looking ahead VITRO utilizes the most advanced science and technology to anticipate the problems that industry will face in the future.

VITRO's major engineering accomplishments have all been well in advance of their time:

- the country's largest titanium facilities
- original uranium gaseous diffusion plants
- extensive plutonium production facilities
- biological laboratories for the government
- two large plants for nerve gas production
- armament evaluation facilities for the Air Force
- many other intricate processing facilities for industry and government

VITRO's eye-to-the-future is effective in many fields of the Atomic Age – metallurgy, nucleonics, chemistry, electronics, refining and processing – all vital to the industrial requirements of the years ahead.

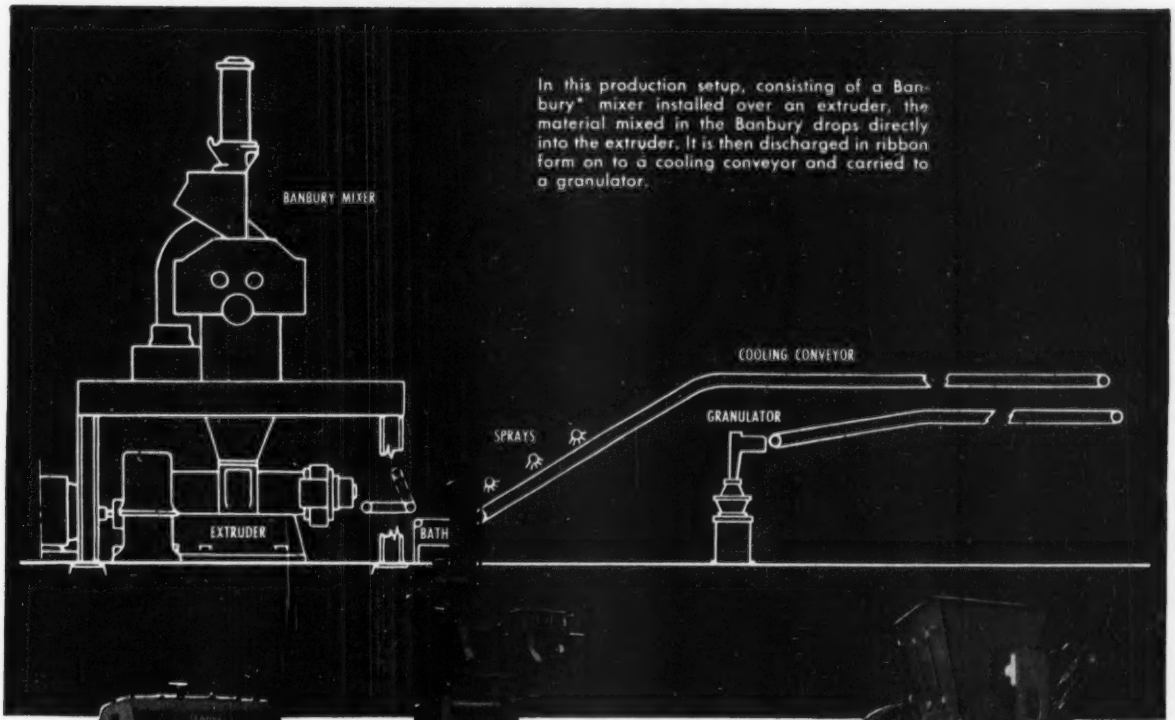
VITRO makes tomorrow's technology available today!

Vitro CORPORATION of AMERICA
261 Madison Avenue, New York 16, New York

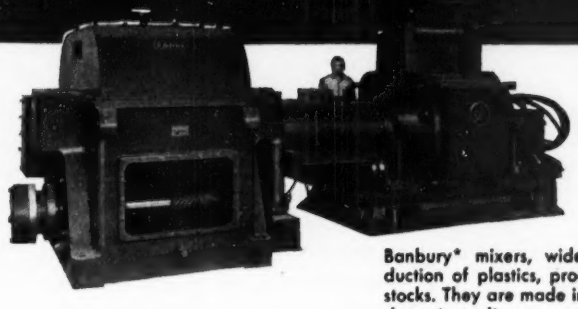
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VITRO MANUFACTURING COMPANY makes ceramic colors and pigments and related chemical products
VITRO URANIUM COMPANY processes uranium ores on the Colorado Plateau for the Atomic Energy Commission
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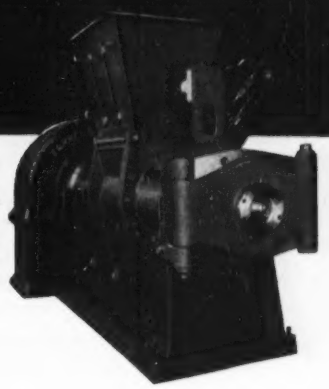
SIMPLIFIED, IMPROVED method of producing plastic materials in granular form



In this production setup, consisting of a Banbury* mixer installed over an extruder, the material mixed in the Banbury drops directly into the extruder. It is then discharged in ribbon form on to a cooling conveyor and carried to a granulator.



Banbury* mixers, widely used in the production of plastics, produce uniformly mixed stocks. They are made in a range of standard sizes to suit any capacity requirements.



Farrel - Birmingham extruders can be built for any capacity and provide the ideal answer to full utilization of maximum Banbury output.

The highly efficient processing system blueprinted here, has been installed by a number of large chemical companies to process plastics in preparation for granulation.

Operation is from a central control panel, and a continuous, even flow of production is maintained at all times by automatic cycle control of the Banbury* mixer, with extruder feed regulated to suit the cycle. The material is mixed and blended in the Banbury, and then delivered in chunk form to the extruder, where the stock is further worked by screw action under close temperature control. An air-operated ram in the hopper automatically provides constant feed to the screw. A continuous strip is extruded from the die head through a water bath to a conveyor, where the material is further cooled on its way to the granulator.

Another application for this production setup is for the reclaiming of vinyl scrap. The scrap is mixed and blended in the Banbury, then discharged into the extruder, where it is strained and extruded in strip form for subsequent cooling and granulation.

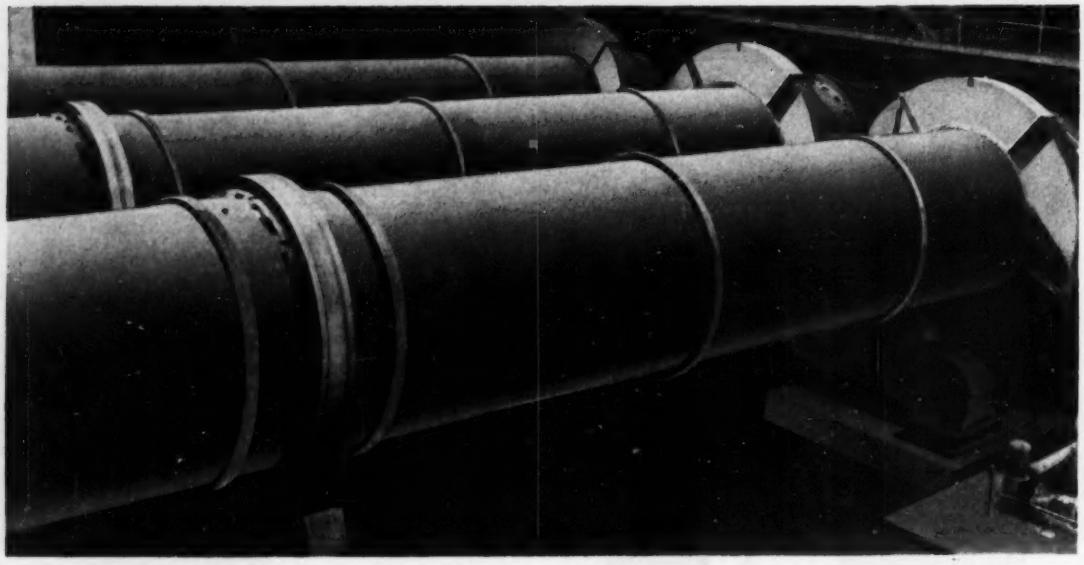
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Farrel-Birmingham ®

*Trade-mark
FB-941

VULCAN ROTARY DRYERS
Designed for
Universal Atlas Reconstruction Program



VULCAN ROTARY DRYERS are included in the new equipment being installed for Universal Atlas Cement Company in Universal, Pa. These VULCAN dryers are one of the many designed by Vulcan for the wide variety of conditions under which materials must be dried.

The units shown above are air heated to 1200 degrees F. and dry limestone and slag at the rate of 2,625 tons daily at the Universal Atlas raw material processing mill. Each dryer is 80 feet long and 8 feet in diameter.

Every detail of every VULCAN Rotary Dryer is designed and built to give maximum performance with a minimum of maintenance. When you build or re-build—before specifying dryers or kilns—contact VULCAN of WILKES-BARRE. Vulcan's manufacturing facilities are of the latest and their engineering staff is highly competent and fully staffed to design complete installations. Let VULCAN, their engineering staff and their 105 years of experience, work for you. Estimates . . . constructive suggestions . . . and preliminary drawings will be furnished, as far as possible, without obligation. Or, write for fully illustrated Bulletin A-442 on Rotary Kilns, Coolers, Dryers, Retorts, and other dependable processing equipment . . . Now.

Any information on items listed below will be sent to you immediately:

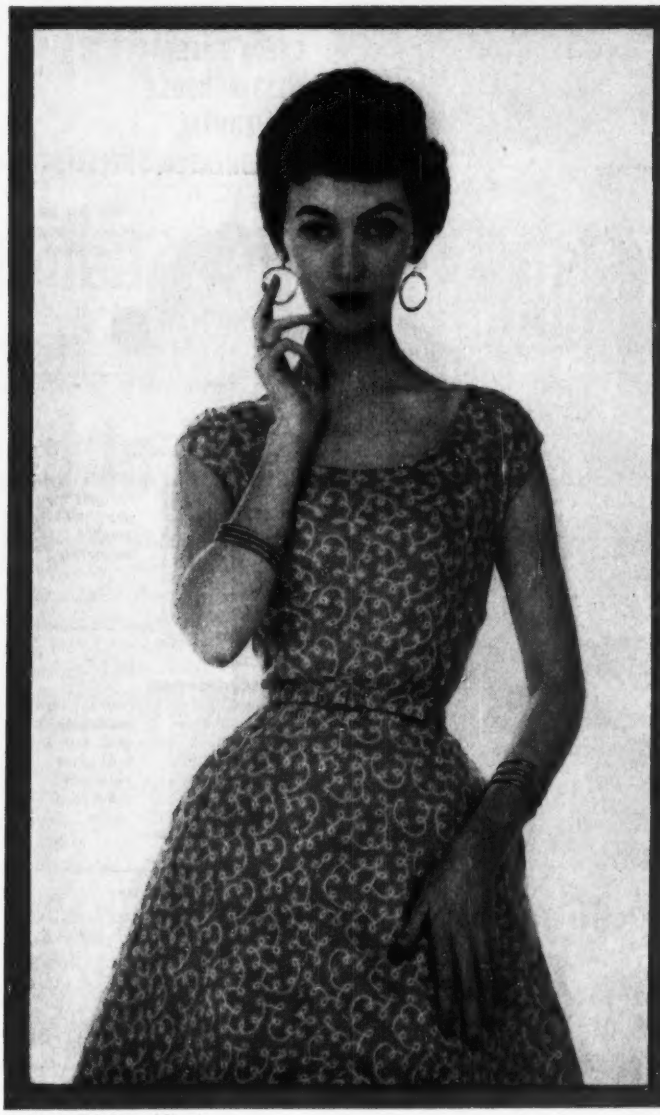
- Rotary Kilns, Coolers and Dryers
- Rotary Retorts, Calciners, Etc.
- Improved Vertical Lime Kilns
- Automatic Quick-Lime Hydrators
- Briquetting Equipment
- Open-Hearth Steel Castings
- Heavy Duty Electric Hoists
- Self-Contained Electric Hoists
- Cast-Steel Sheaves and Gears
- Diesel Locomotives
- Electric Locomotives and Larrys
- Steel Plate Fabrications
- Hydraulic Presses

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WILKES-BARRE, PA., U.S.A.
ESTABLISHED 1849

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PETROHOL 99
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Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Dicyclopentadiene
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

CHEMICAL

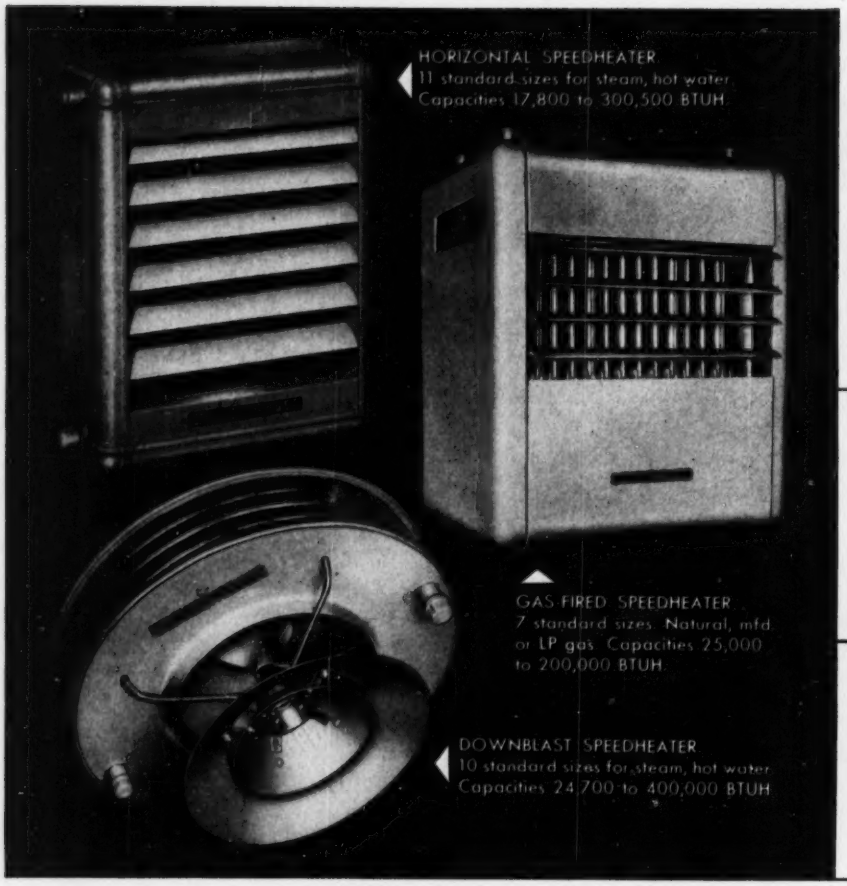
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PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
Ethyl Ether
Isopropyl Ether
Tetrapropylene
Tripropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

34 successful years of leadership in serving industry

Meet America's most important consumer. The woman whose judgment makes or breaks a sale in more and more fields today. She buys the look, wear, work and performance of a product . . . she demands *proved results.*

That's why it pays to back *your* product with the research, experience, know-how and *proved results* of the Enjay Company. Enjay is a recognized leader in developing and marketing a complete line of uniform, high quality petroleum chemicals for the chemical, petroleum and surface coating industries. Specify Enjay for the dependable ingredients that assure *proved results.*

ENJAY CO., INC. • 15 West 51st Street, New York 19, N.Y.



CHECK THESE WESTINGHOUSE HORIZONTAL SPEEDHEATER SPECIALS!

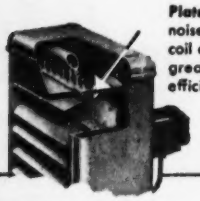
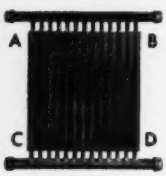


Plate fins cut noise, minimize coil clogging for greater efficiency.



Pliable steel hangers (no extra cost) simplify installation.



Four connection combinations (A-C, B-D, A-D, B-C) allow tight-spot installation.

The traditional value in unit heaters—

Westinghouse Speedheaters®

for instant heat... quiet heat... low-cost heat

Built for strength, built for style, built to install easily and satisfy for years.

For today's outstanding heating value, look to a pioneer name in unit heaters—look to Westinghouse Speedheaters! Check, before you specify, all the features that add up to traditional Speedheater superiority:

(1) instant heat—generated at the flip of a switch, and all of it effective heat because the Speedheater one-row, plate-fin heating element assures most efficient heat flow;

(2) quiet heat—the Speedheater, always known for silent operation, is quieter than ever! Aluminum plate fins, mechanically bonded, cut noise . . . rugged, welded construction eliminates rattles . . . powerful die-formed fans send heat where it's needed, do it *quietly;*

(3) low-cost heat—heat that saves dollars on fuel (up to 25% savings in present installations over old-style systems), more dollars in pure-and-simple efficiency in heating spots or large zones, in supplementing central systems in any required pattern.

Check other Speedheater values, too: the pliable steel hanger straps and flexible connection combinations (see cuts) that simplify Horizontal model installation . . . the multiple-cone diffusers on Downblast model that give positive heat control, especially desirable for buildings with high ceilings . . . the all-purpose AGA-approved Gas-Fired model that eliminates the need for central system heating. For full information call your Westinghouse-Sturtevant heating specialist now. Or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

J-80421

DESIGN and PRODUCTION NEWS

FOR PLASTICS AND MATERIALS ENGINEERS

Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company OCT.-NOV. 1954

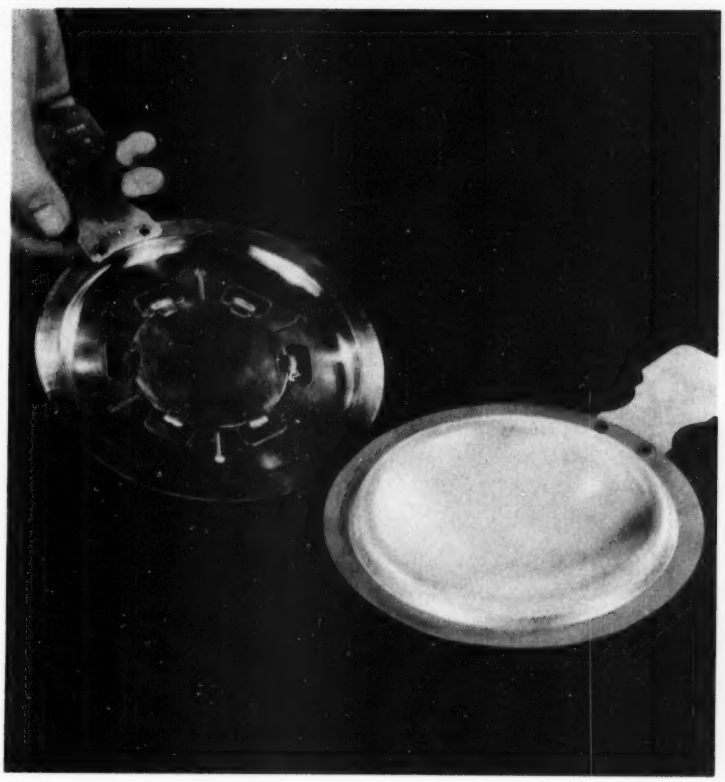
Smaller, Lighter Rupture Discs... Lined With KEL-F® Plastic... Now Used In Highly Corrosive Systems

Using coatings and seals of KEL-F plastic to overcome corrosion, lightweight, small rupture discs of aluminum now provide protection for low pressure and vacuum vessels. Discs with bursting pressures ranging from 5 to 100 psig are now possible. Premature bursting due to corrosion has been eliminated. Discs are smaller and afford a greater degree of pressure control than was possible with previous types.

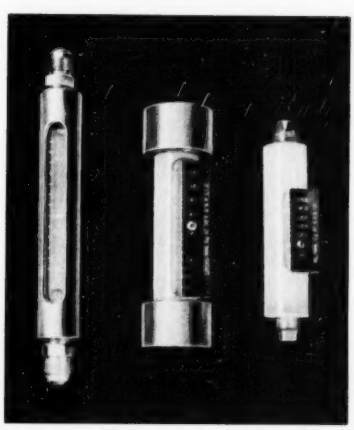
A lining of KEL-F plastic on the standard (right) and a film seal in the new "lug" type rupture disc (left) permit them to be used safely with practically all known corrosive materials, at temperatures up to 250°F.

Black, Sivalls & Bryson, Inc., Kansas City, Mo. manufacturers of special control equipment, pioneered this use of KEL-F plastic film. B S & B uses unplasticized "Trithene"* (KEL-F polymer) film produced by The Visking Corporation, Terre Haute, Ind. in many types of rupture discs.

**Registered trade-mark of The Visking Corporation*



For further information ask for Application Report C-119



HF at 300°F Handled by Flowmeters of KEL-F® Plastic In Atomic Plant ...Still "On Stream" After 2 Years!

Clarity, dimensional stability, accuracy and damage resistance make these flowmeters made from KEL-F polymer outstanding. In contact with extremely corrosive hydrogen fluoride for two years on low-pressure purge lines, they show no signs of "giving up".

Chemically-inert, the plastic tubes are unattacked by the HF even at 300°F. Machined to precision dimensions, they maintain original metering accuracy. Flow tubes have remained clear to permit easy float visualization.

The Brooks Rotameter Company, Lansdale, Pa., produces these corrosion-resistant flowmeters. Flow tubes are machined of rod extruded from KEL-F polymer Grade 300 by the United States Gasket Company, Camden, New Jersey.

For further information ask for Application Report C-120

(SEE REVERSE SIDE)

® *Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.*

KEL-F

TRIFLUORO CHLORO ETHYLENE POLYMERS

KEL-F

MOLDING POWDERS

KEL-F

FLUORO CHLORO CARBON PLASTIC

KEL-F

DISPERSION COATINGS

KEL-F

TRIFLUORO CHLORO ETHYLENE POLYMERS

KEL-F

OILS WAXES GREASES

CONTINUED FROM PRECEDING PAGE

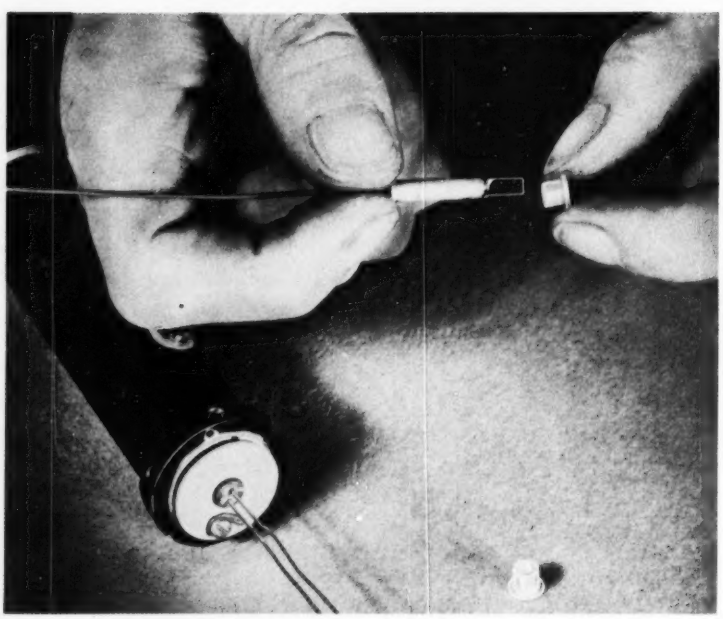
Paper-Thin Insulator of KEL-F® Polymer Solves Space, Precision "Specs" Problem in Microwave Cavity

Found to be the *only* high-frequency dielectric capable of being machined to close tolerances in this .009" thick insulator, KEL-F plastic effectively prevents pulse leaks between cavity and probe. These units, producing hundreds of watts peak power output, depend largely on the insulator for their 0.0005% per °C temperature coefficient.

The fluorocarbon's high dielectric strength over a wide temperature range and its dimensional stability assure complete insulation in the limited space provided. Zero water absorption of this fluorocarbon guards the insulator against any changes caused by moisture.

The precision insulator is machined from KEL-F polymer rod and installed in microwave oscillator assemblies by C.G.S. Laboratories, Inc. of Stamford, Conn. C.G.S. obtains its rod stock from the Resistoflex Corporation, Belleville, N. J. who extrude it from unplasticized KEL-F polymer.

For further information ask for Application Report E-127



Molders & Fabricators of the Month

Leading molders, extruders and fabricators specialize in the production of materials and parts made of "Kel-F" . . . each month this column will spotlight several of these companies with their principal services and products.

Booker & Wallestead, Inc.
Minneapolis, Minn.
Injection molding
Compression & transfer molding
(Specialize in short runs)

H & R Industries
Nazareth, Pa.
Extrusion & injection molding
Machining & forming
Rod, tube, tape & strip
Resistor sleeving

Electronic Wave Products, Inc.
New York, N. Y.
Sealing of film
Forming
Container liners; gaskets

Reiss Manufacturing Corporation
(Rway Synthetic Products Div.)
New York, N. Y.
Extrusion, compression & transfer molding
Machining & forming
Rod, tube & sheet
Gaskets & diaphragms
Valve seats

Recent Significant KEL-F Polymer Developments . . .

Blending equipment is now coated with "baked-on" KEL-F polymer dispersions to eliminate wasteful sticking of special plastics during processing. Chemical inertness and non-stick qualities of coating have cut maintenance and contamination.

Switch seals of the plunger type are now molded of fluorocarbon polymer to provide a hermetic seal that will withstand high altitudes and temperatures.

Valve seats machined from KEL-F polymer rod stock are used in a special valve required in nuclear research. Non-porous, tough plastic effectively keeps active Helium isotope from diffusing through the seat. Low "cold flow" keeps seats smooth and undamaged even after many "high torque" closings.

Covers for high-frequency components are compression molded of fluorocarbon polymer for electrical insulation as well as maximum visibility of contained parts. High impact strength and resistance to aging eliminates need for special protective or reinforcing shields or guards.

OFF THE PRESS . . .
Revised "BUYERS GUIDE" listing KEL-F polymer products, molders and fabricators.

For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write
Technical Service
CHEMICAL MANUFACTURING DIVISION
THE
M. W. KELLOGG COMPANY
P. O. Box 469, Jersey City 3, N. J.
or offices in Boston, Chicago, Dayton, Los Angeles and New York
KELLOGG PULLMAN

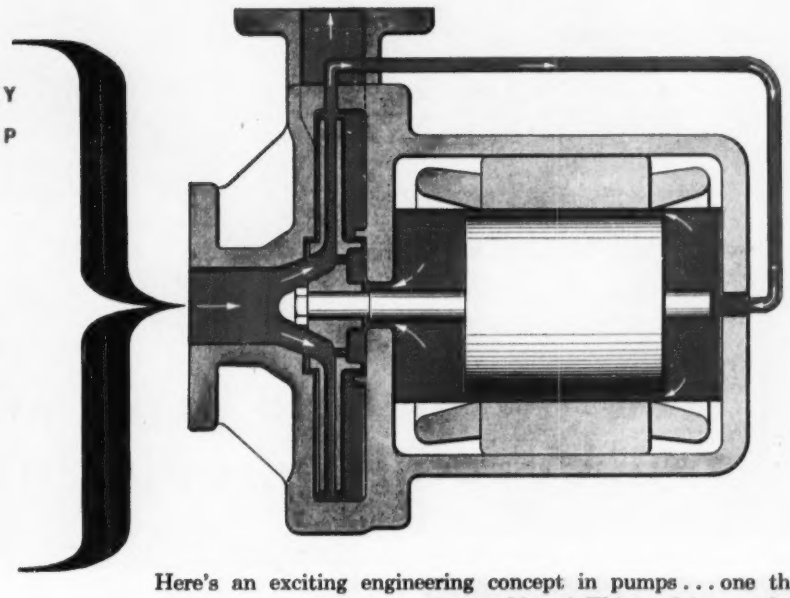
® *Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.*

Chempump...a centrifugal...

has no shaft seal or stuffing box—IT CAN'T LEAK

TYPICAL FLUIDS EASILY HANDLED BY CHEMPUMP

- Hydrofluoric Acid
- Nitric Acid
- Formaldehyde
- Trichlorethylene
- Titanium Tetrachloride
- Organic Solvents
- Carbon Disulfide
- Freon
- Dowtherm



Here's an exciting engineering concept in pumps . . . one that eliminates pump maintenance problems! Think of it: no shaft seal . . . leak proof . . . no stuffing box . . . no lubrication . . . totally enclosed, motor and all! Benefits? No leakage or contamination of fluids . . . seals-in expensive, toxic, or corrosive fluids . . . protects plant and personnel.

The combined rotor and impeller assembly, actuated by a radial magnetic drive is the only moving part! Fluids circulate through the rotor chamber of the motor. The stator is isolated from the fluid by a corrosion-resistant, non-magnetic alloy cylinder. And the rotor is hermetically sealed.

Chempump is available in from ⅛ up to 3 horsepower; Capacity range is from 0 to 180 gallons per minute. Discharge heads from 3 to 90 feet. Materials of construction—wide selection of alloys available. Prices start at $96 for stainless steel construction.

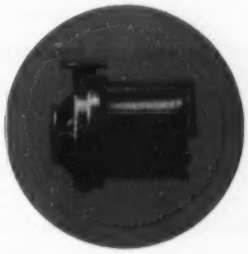
Write at once for more data on this "years-ahead" centrifugal pump.



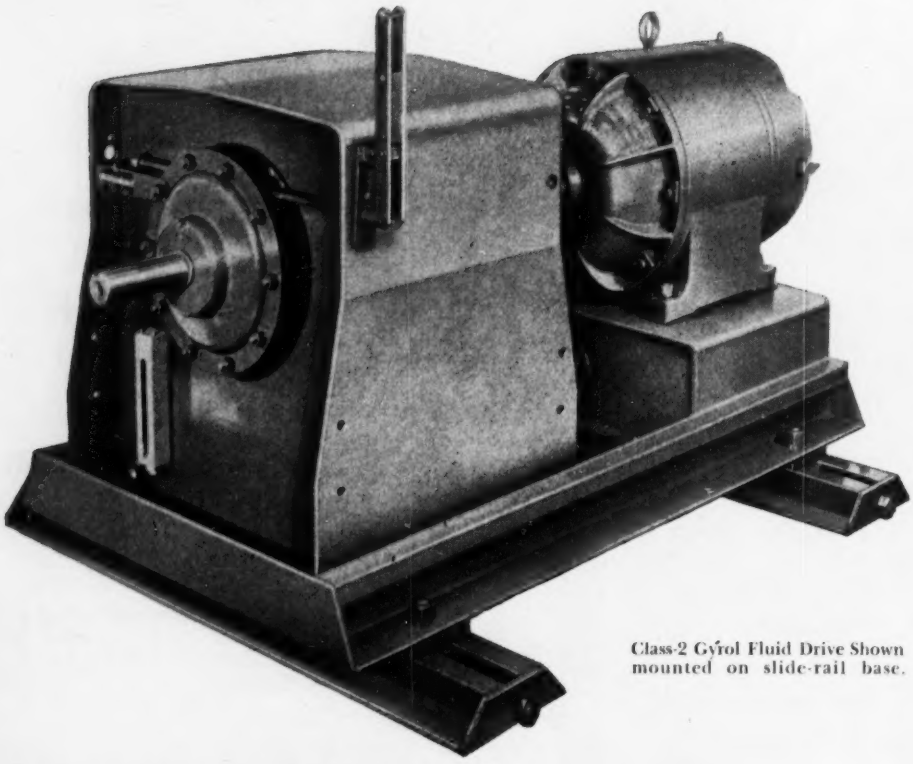
Bulletin G-1000 contains complete data.
Send for your copy, today.

CHEMPUMP CORPORATION

1322 EAST MERMAID LANE • PHILA. 18, PA.

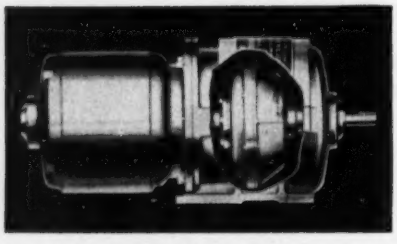


ENGINEERING REPRESENTATIVES IN OVER 30 PRINCIPAL CITIES IN THE UNITED STATES AND CANADA



Class-2 Gyrol Fluid Drive Shown mounted on slide-rail base.

New Gyrol fluid drive offers dual rotation,* adjustable speed



For smaller applications—American Blower TM Constant-Speed Gyrol Fluid Drive. Available in ratings from 1 to 20 hp.

Get the facts today!

Write to: American Blower Corporation, Dept. 180-6, Detroit 32, Michigan. Ask for a copy of Bulletins 9419 and 9519. They will be sent to you promptly along with any other information you may require.

Look at all these features

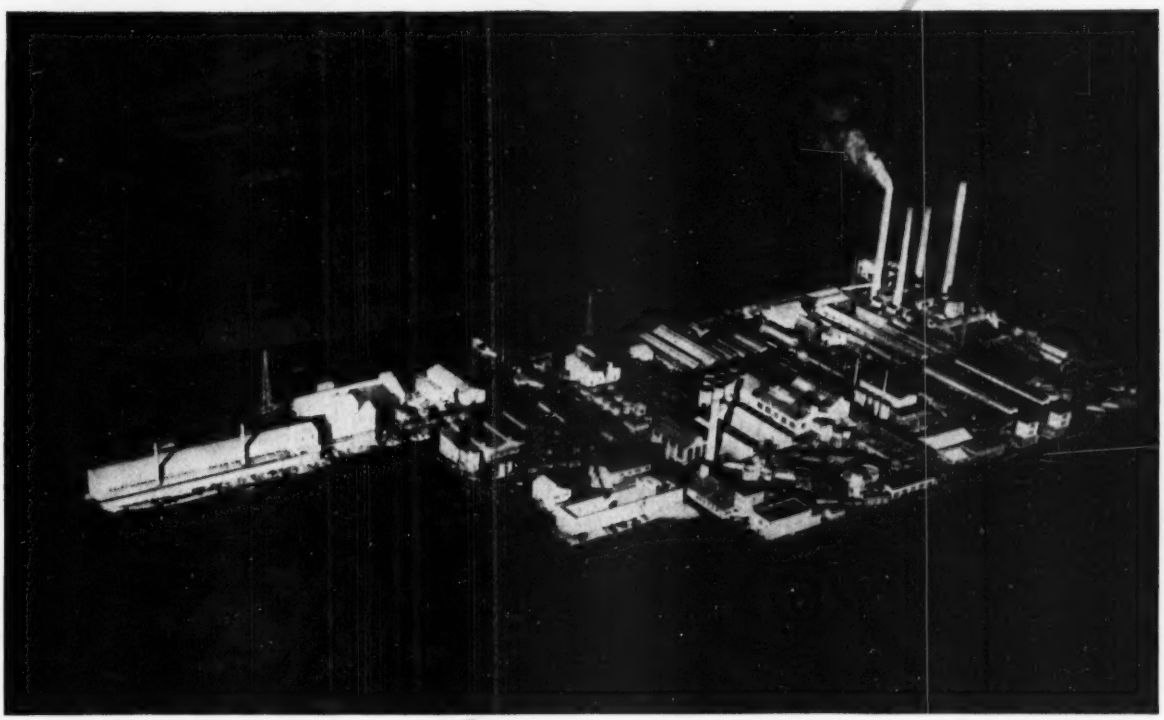
- *Can be reversed while in motion by reversing motor
- Trigger-action response—adjustable speed
- Speed range 5-1
- Permits across-the-line starting on many applications
- Motor can reach full speed before engaging load
- A compact, self-contained unit
- Speed may be controlled manually or automatically
- Six sizes, 7½ thru 800 hp — speeds up to 1800 rpm

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Oh, I see



South Charleston, West Virginia plant of Westvaco Chemical Division of the Food Machinery and Chemical Corporation.

. . . they're using our valves

at Westvaco CHEMICALS



Efficient, dependable valves can lower your processing costs. First by controlling flow precisely, then by providing extra-long wear to reduce costly maintenance.

Positive flow regulation is the first thought of OIC Valve Engineers. Then materials used in OIC Valves are selected, machined and assembled to provide maximum endurance . . . long mechanical life. For these reasons, Westvaco and others in the chemical field give OIC ready acceptance.

Write for catalog information or engineering assistance.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 1883

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**



YOU'RE PAYING FOR PREHEAT

WHY NOT USE IT?

Fuel costs getting you down? In a year or so, a Ljungstrom Air Preheater could pay for itself in fuel savings alone.

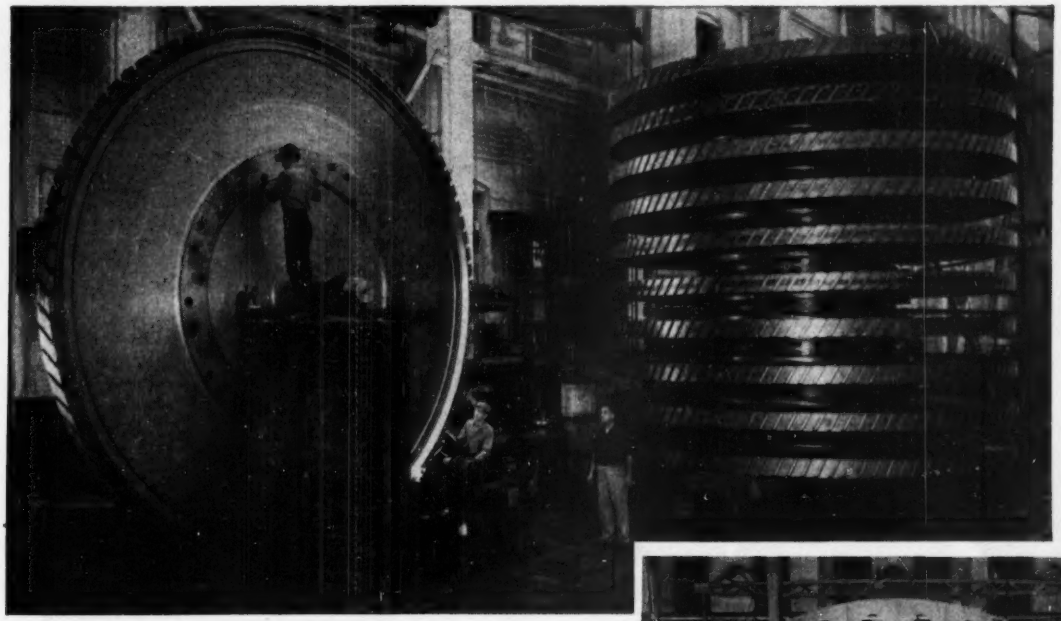
Trying to boost your capacity? Four of your present units could do the work of five with Ljungstroms on the job, increasing each unit's output as much as 25%.

Turnaround taking too big a slice out of on-stream time? A Ljungstrom Air Preheater makes fuel burn more completely – at a higher temperature – greatly reducing the rate of slag build-up on furnace tubes. You'll stay on-stream longer – year in and year out – with a Ljungstrom.

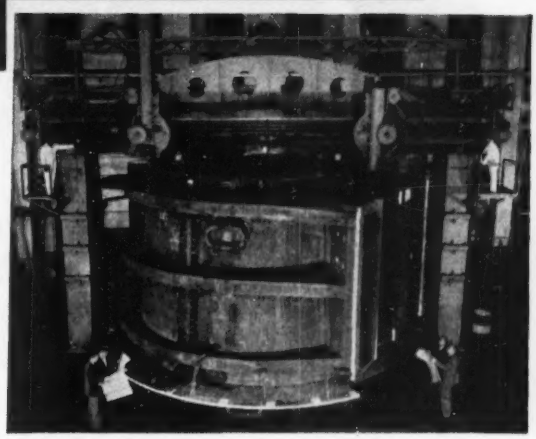
Our Engineering Staff will be happy to show you how others have saved up to 20% on their annual fuel bills . . . increased throughput as much as 25% . . . reduced slagging and actually improved product octane ratings with Ljungstrom Air Preheaters. Write today for full details.

WHEREVER YOU BURN FUEL, YOU NEED LJUNGSTROM

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



Rotor discs for mammoth 11-stage compressor were balanced and stacked for alignment in one of Newport News' five huge machine shops. Large engineering and technical staffs with a vast plant make Newport News an ideal source for large equipment . . . *standard or special in design.*



A 35-foot boring mill in Newport News' plant machining the 374,000-pound upstream housing for the giant axial flow compressor. The compressor is heart of an 8-foot supersonic wind tunnel at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics at Moffett Field, Calif.

To create winds exceeding

2000 MPH

Newport News builds world's Mightiest Compressor

Whenever you want large units built with careful attention to detail, give the job to Newport News.

This company recently built an eleven-stage axial flow compressor that shatters all previous records for wind force . . . using what is believed to be the world's largest rotating object.

The rotor, weighing more than 400 tons, comprises eleven huge discs. Each disc, machined from a 96,000-pound forging, was finished to a 50,000-pound wheel and balanced to within 26 ounces at the rim. In each rim, slots for blades were machined to within .005" on special milling heads designed and produced in the Newport News plant.

Here at Newport News, you'll find more than large productive capacity. In machine shops, foundries and forging plants Newport News craftsmen complete your orders with specialized techniques backed by experience in fabricating thousands of products.

Newport News' craftsmen produce units that range from small components of spinning machines, to mammoth hydraulic turbines . . . from piping, pumps and valves, to vacuum tanks, digesters and bridge caissons.

These skilled men handle the job exactly as you want it done, for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and products" . . . it's your for the asking.

Newport News

Shipbuilding and Dry Dock Company

Newport News, Virginia



Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters.
No dust filters.
No internal lubrication to contaminate air handled.
No internal wearing parts.
No valves, pistons, or vanes.
Non-pulsating pressure.
Original performance constant over a long pump life.
Low maintenance cost.

NASH ENGINEERING COMPANY
395 WILSON, SO. NORWALK, CONN.

We can CUT your Bulk Material Handling Cost



Let us prove . . . BY A DEMONSTRATION . . . the many advantages of loading with the combination of Clutch-Type Transmission and Hydraulic Torque Converter . . . brought to you by the

TRACTOMOTIVE TL-10 TRACTOLOADER

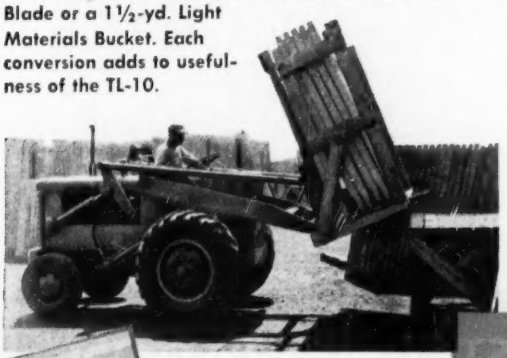
SEE how the smooth-operating HYDRAULIC TORQUE CONVERTER DRIVE speeds loading — no butting or ramming, no engine stalling. No clutching either — operator crowds steadily into pile using only the foot throttle and bucket control levers. Wheel spin is practically eliminated, tire wear greatly reduced. Bucket action is snappy at all times because speed of engine and hydraulic pump remain constant.

SEE how the specially designed CLUTCH-TYPE TRANSMISSION eliminates most shifting. You simply push a lever to go forward, pull it back for reverse. Reverse is almost twice as fast as forward.

SEE how easy it is to maneuver the TL-10. Bucket over drive wheels utilizes weight of load for greater traction... eases weight on rear steering wheels. Turning radius is only 11 ft. at tip of bucket . . . works in areas that would normally accommodate only lower capacity machines. You can turn from a 9-ft. aisle into a 10-ft. bin!

Only by watching the TL-10 work can you fully realize the great savings you can make on bulk material handling. Let us arrange a demonstration NOW! Wire, write or call.

Added Versatility **Standard bucket is quickly interchangeable with Lift Fork, Crane Hook, Dozer Blade or a 1½-yd. Light Materials Bucket. Each conversion adds to usefulness of the TL-10.**





Write to us — **for literature on the TL-10 and see your nearest Allis-Chalmers Industrial Tractor Dealer.**

Never-Anywhere— A WHEEL LOADER LIKE THIS!

¾ cu. yd. bucket — weight 11,400 lb. — 63 brake hp. Has dynamic, new Allis-Chalmers POWER-CRATER engine . . . gives you high-octane performance on regular gasoline.

POWER-CRATER is an Allis-Chalmers trademark.

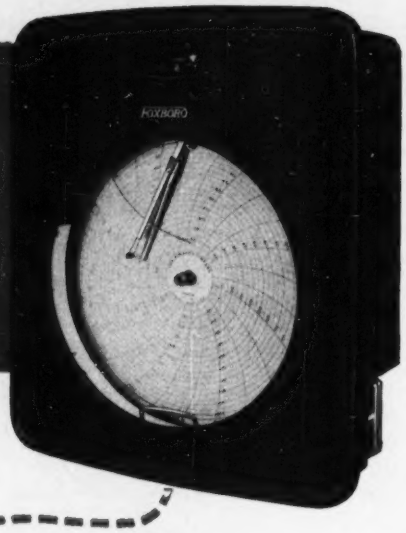
TRACTOMOTIVE

TRACTOMOTIVE CORPORATION, DEERFIELD, ILLINOIS

Tracto-Loaders • Tracto-Shovels, Side Booms and Hydraulic Rippers for Allis-Chalmers Crawler Tractors • Loader and Shoulder Maintainer for Allis-Chalmers "D" Motor Grader

An unbeatable team for temperature measurement

DYNALOG RECORDERS and DYNATHERM BULBS



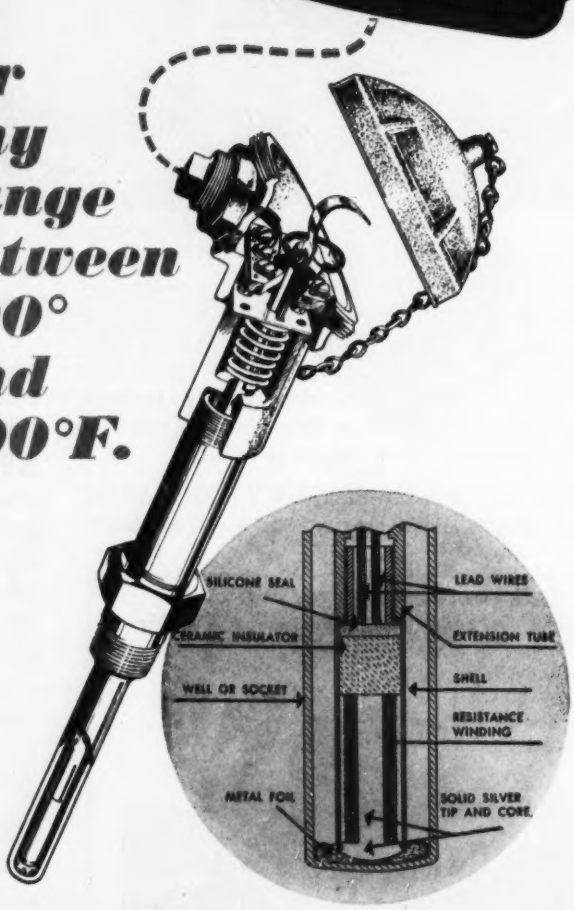
You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between–100° and+600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

The Dynatherm Resistance Bulb has unique features including metal-to-metal end-contact which, when installed in a well or socket, gives a speed of response unsurpassed by any other similarly protected temperature-sensitive element. Exceptionally rugged and permanent in calibration.

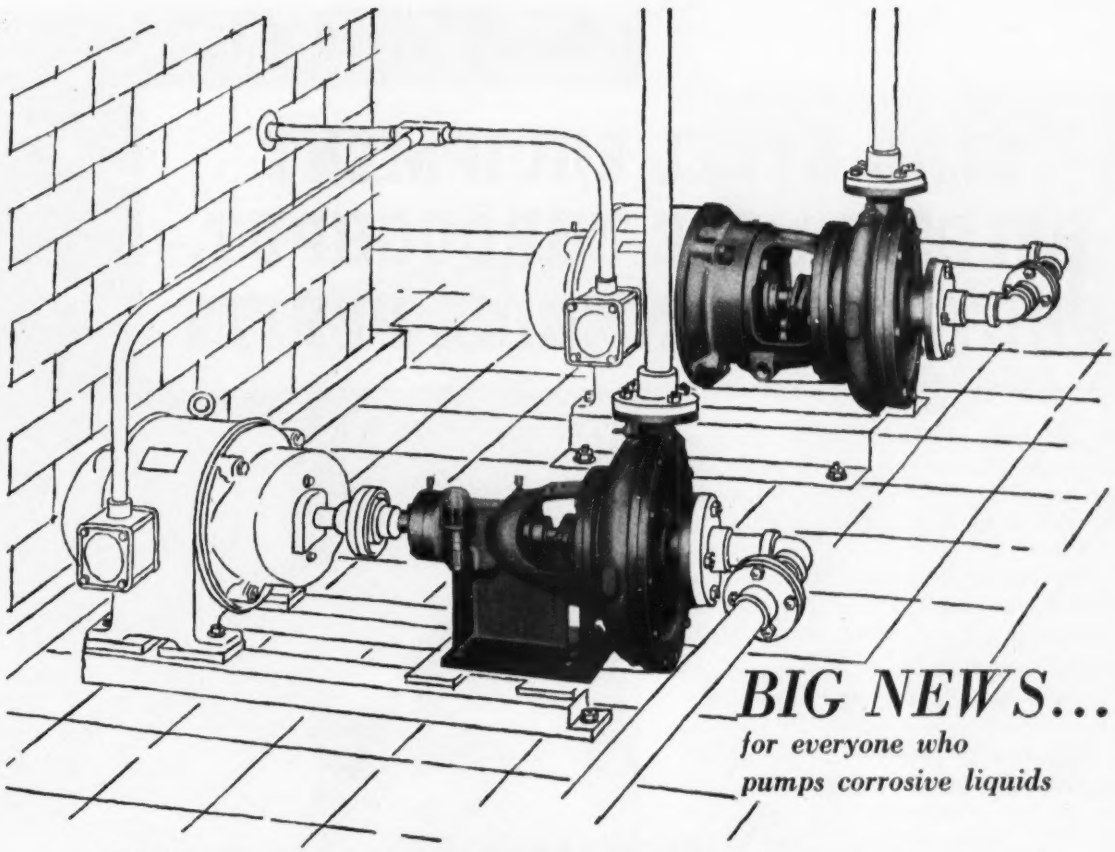
These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins, The Foxboro Company, 3610 Neponset Ave., Foxboro, Mass., U.S.A.

for any range between -100° and +600°F.



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FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



BIG NEWS...

for everyone who pumps corrosive liquids

Now you can get the **"custom-built"** *features you want at no penalty with the new* **AMPCO* Centrifugal Pump**

In a given pump size, new standard units give at least 108 different combinations, plus maximum resistance to corrosion, erosion, cavitation

Here's low-cost corrosive liquid transfer at its new, versatile best. If you require pumps in flows up to 600 gpm, this new 1750 rpm pump is exactly right for you. It can be built to *your* special requirements by interchanging standard parts.

You can select the bearings you want — sealed, replenishable-grease, or oil-lubricated.

You can choose your shaft seals — inside or outside mechanical seals; internal, external, or flushing packed stuffing-boxes.

You can get the exact shaft you need — no compromising. Take your choice of general-purpose and extra-rigid shafts as well as a new two-piece unit that allows removal of the rotating parts without disturbing coupling, bearings, or alignment.

You can select the pedestal height and type impeller you want.

Best of all, you don't have to buy another pump when conditions change. You can make modifications quickly and inexpensively in the field — save yourself valuable time and money.

Corrosion damage? Forget it. These pumps are built entirely from Ampco or other workable alloys to combat the effects of corrosive acids, alkalis, organic chemicals, etc. And these pumps have many new design features — features that contribute to dependable, maintenance-free pumping.

The new Ampco 1750 rpm Pumps are now stocked for immediate delivery. Contact your Ampco Pump Distributor or Field Engineer or mail the coupon.

Ampco Metal, Inc.
Dept. CE-10, MILWAUKEE 46, WISCONSIN
West Coast Plant • Burbank, California

Fill out this coupon and mail today

AMPCO METAL INC., Dept. CE-10, Milwaukee 46, Wisconsin

The new Ampco Pump sounds good to me. Send me additional information. I pump.....

Name.....Title.....

Company.....

Company Address.....

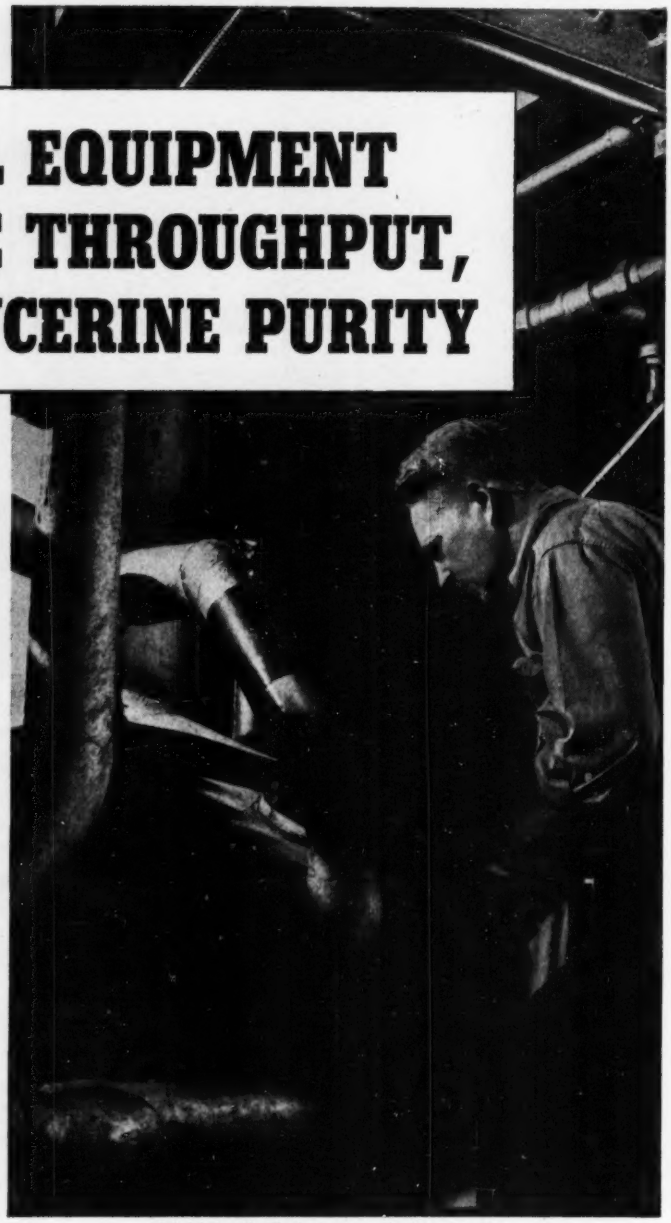
City.....(.....) State.....

*Reg. U. S. Pat. Off.

Maximum Interchangeability without Penalty

P-13

CLAD STEEL EQUIPMENT HELPS TRIPLE THROUGHPUT, PROTECTS GLYCERINE PURITY



Multiple distillation was eliminated with this new corrosion-resistant clad steel still.

Even after slow and costly distillation, this soapmaker was plagued by poor quality "yellow distilled" glycerine. Then a new distillation unit was designed featuring a still pot with solid nickel coils for faster heating, nickel-clad steel shell for vital corrosion resistance. Results: redistillation eliminated, throughput tripled, and a 70% cut in fuel costs which saved $7,000 a year.

The advanced design of this new equipment called for both the performance and economy of clad steel. Nickel cladding, inseparably bonded to the lower cost carbon-steel backing, does the work of expensive, solid high alloy in plate form at substantial savings. Clad's corrosion resistance protects the product *economically*, assuring that it will be pure and free from contamination. Important also, the still has the strength needed to withstand high vacuum operation.

Equipment performance like this results from teamwork between the equipment builder and design and production engineers. Are you looking for maximum productivity . . . low-cost, trouble-free operation . . . and long equipment life? You'll find that sound engineering and modern fabrication techniques employing versatile clad steels can provide these advantages for you. It pays to consult your fabricators *early* in your planning. They will work with your engineers and consultants, can often provide cost-saving suggestions in giving you the specialized equipment you want.

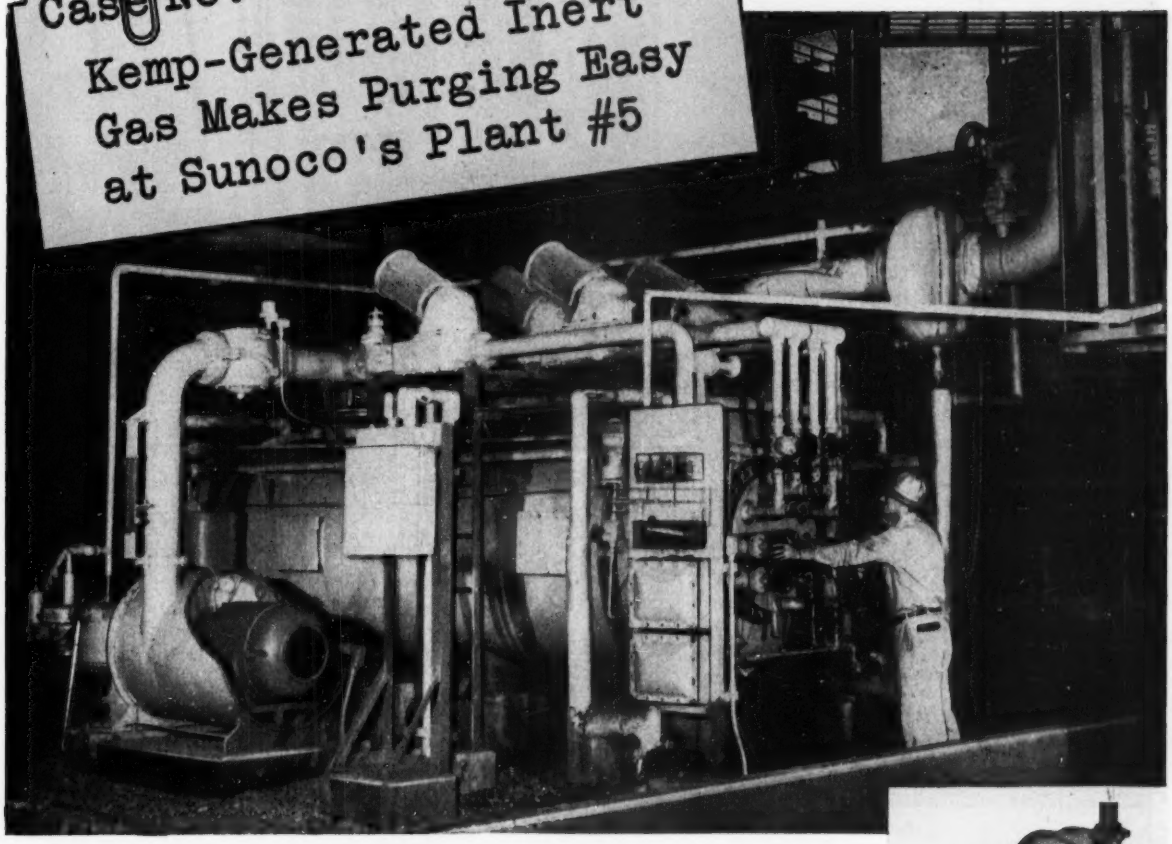
Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. Its story contains ideas of interest to everyone concerned with production efficiency and economy. Or contact Manager, Marketing Service, Lukens Steel Company, 678 Lukens Building, Coatesville, Pa.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

Case No. 57
Kemp-Generated Inert Gas Makes Purging Easy at Sunoco's Plant #5



How Sun Oil's "Magic Mill" at Toledo operates with 'round the clock safety

There's no *one* word that strikes terror in the hearts of oilmen everywhere more quickly than F-I-R-E! To combat this threat at the Sun Oil Co.'s giant refinery at Toledo, Ohio, constant vigilance, checks and inspections are the answer. And the liberal use of inert gas for purging pipelines, tanks and crackers is essential to this safety maintenance.

Kemp selected to do the job

When plans called for *doubling* plant production in 1950, a new Kemp Generator (see above) was installed to insure adequate inert gas production. Fast-starting, easy-to-operate, this Kemp unit more than filled the bill. Today tanks and lines are periodically purged for inspection and cleaning *as often as needed*. And thanks to its 60,000 cu. ft. per hr. Kemp Inert Gas Generator, Sunoco enjoys *exact analysis* inert production that meets all its purging requirements.

Let Kemp help you, too

If you have a purging or blanketing problem, why not let Kemp Engineers give you the same helpful advice used so profitably at Sun Oil's Toledo refinery. It costs you nothing to investigate. And it may save you money. Find out how Kemp's wide range of dependable, low-cost Generators (complete with the latest fire checks and safety devices) offer you the best way to solve your problems.

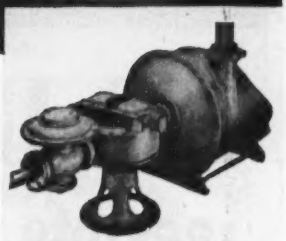
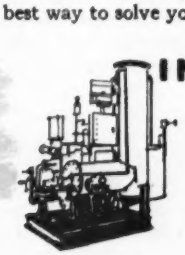


Photo above shows close-up view of Kemp Industrial Carburetor, the heart of every Kemp installation. Assures complete combustion... without waste, without tinkering. Reduces installation costs, simplifies maintenance.

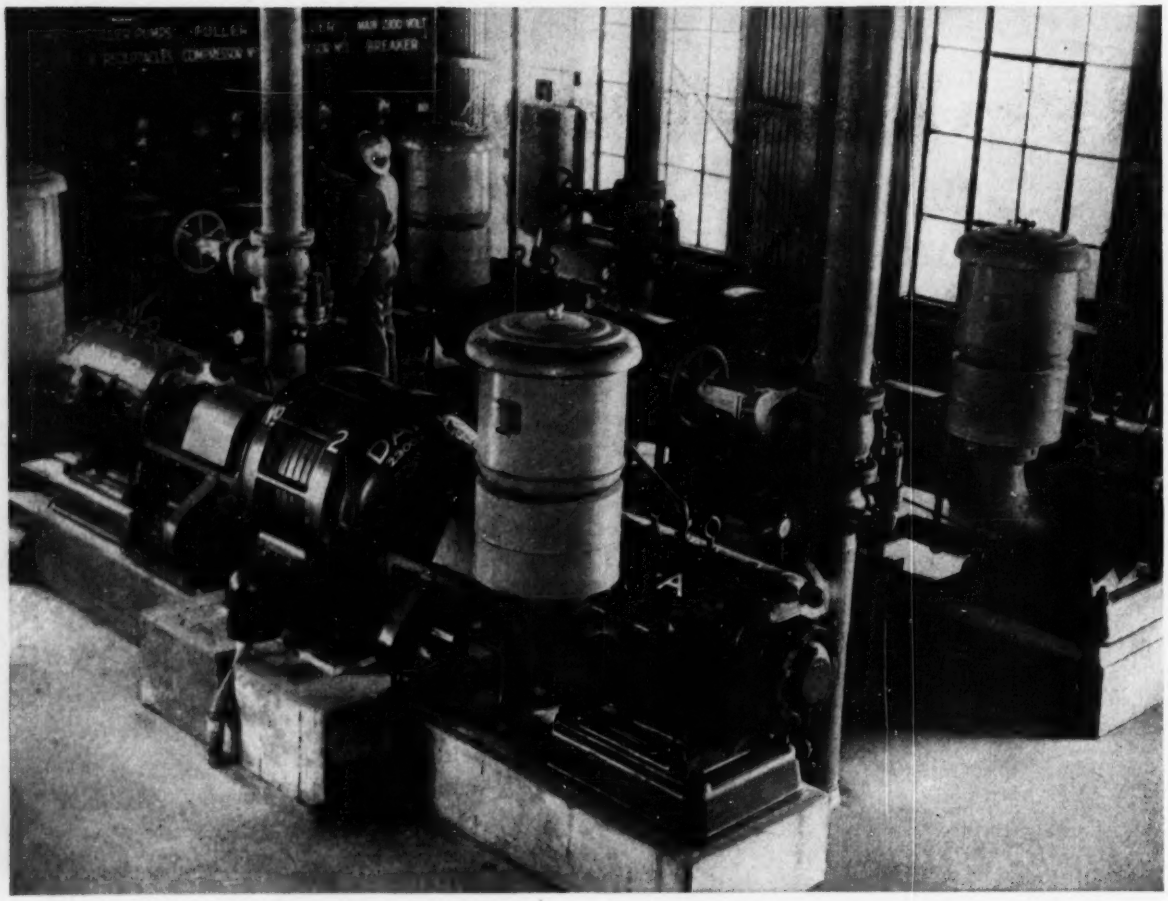
For more complete facts and technical information, write for Bulletin I-10 to:
C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland.

KEMP OF BALTIMORE



INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE DRYERS • SINGEING EQUIPMENT



Fuller Rotary Compressors
operate with minimum maintenance cost

Fuller Rotary Compressors installed in the Permanente Cement Company's bulk-cement storage and ship-loading plant at Redwood City, California, do yeoman duty supplying air to the Fuller-Kinyon Conveying System installed in the plant. These two Fullers, illustrated above, are of the single-stage duplex type, each having a capacity of 2040 c.f.m., actual free-air delivery, with 40-lb. discharge pressure.

These compressors are kept busy. During the year 1953, the Redwood City plant shipped approximately 2-3/4 million barrels of cement; however, the Fuller Rotary Compressors supplied the air to the Fuller-Kinyon System for handling it twice—incoming to storage and outgoing from storage to ships—for a total volume of approximately 5-1/2 million barrels. And, this mammoth task was accomplished with a total maintenance cost of only $130.00 for both machines!

Such operation is the result of two important factors: (1) equipment designed and built to give satisfactory service under all kinds of working conditions; (2) careful overall supervision of the equipment, and good housekeeping by the operating personnel in the plant.

In this operation it is highly essential that these compressors operate at the highest efficiency when ships are being loaded, because wharfage charge is $2.00 for every minute the ship is tied up to the wharf, in addition to operating cost of the vessel.

Thousands of Fuller Rotary Compressors are operating in various industrial plants, giving unqualified satisfaction and service, day in and day out. They're built in single and two-stage units for capacities to 3300 c.f.m., pressures to 125 pounds. Write for Bulletin C-5A, for a complete description of these modern machines.

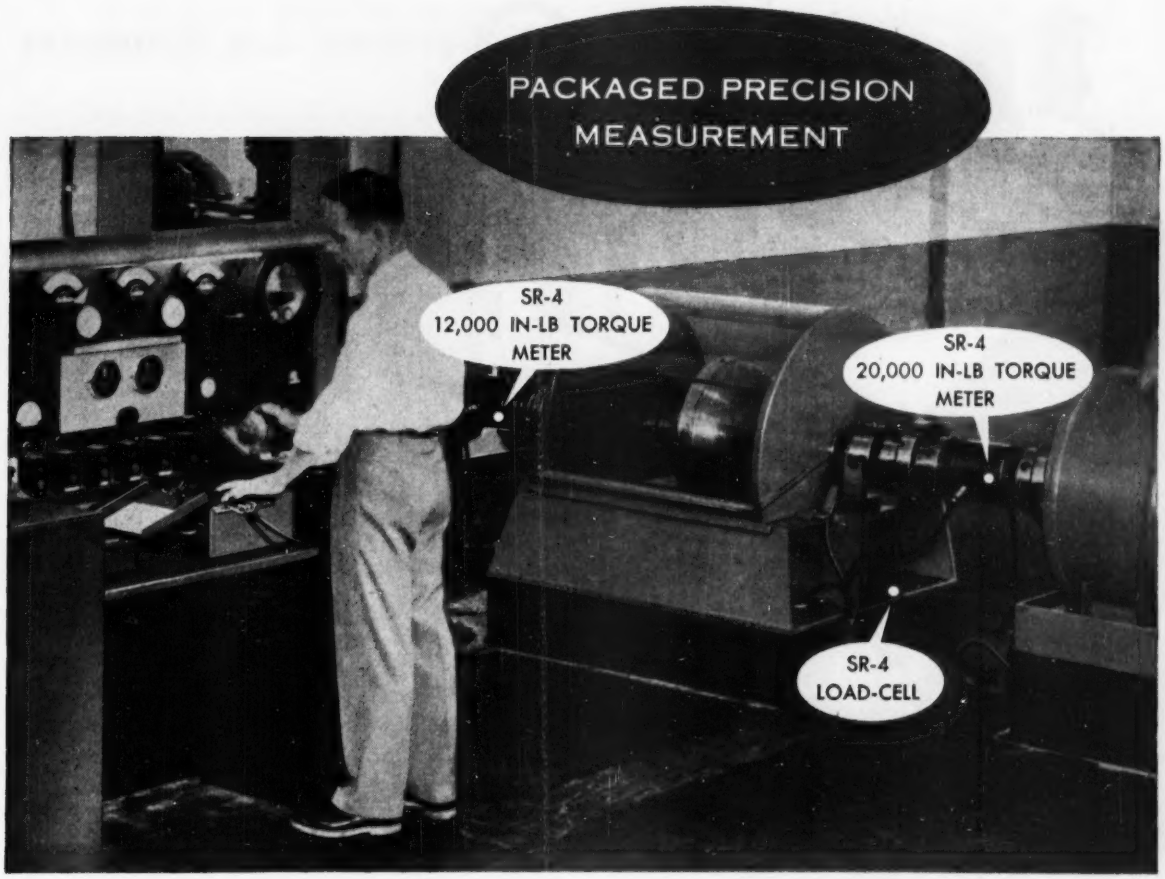
Fuller

FULLER COMPANY, Catasauqua, Pa.

Chicago • San Francisco • Los Angeles • Seattle • Birmingham

C-257
1170

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS



National Supply measures torques and thrusts accurately and easily with SR-4® system

At their Toledo plant National Supply Company is using Baldwin SR-4 Torque-meters and Load Cells to measure torques and thrusts during development of torque converters. They report that the torquemeters are both accurate and convenient in measuring the efficiency of their new converters. Calibrations of load cells resulted in satisfactory reports.

By using Baldwin's SR-4 Torque Measuring System, National Supply benefits in three ways: (1) *reliable accuracy* over wide torque range. (2) *convenience* because of easy mounting. (3) *trouble-free operation* due to rugged construction and absence of moving parts.

You will profit, too, by using *Baldwin Packaged Precision Measurement*. Write now for our new booklets which will tell you how you can benefit by using SR-4 Device systems to measure electronically either load, torque or fluid pressure. Write to Department 3304, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

BALDWIN-LIMA-HAMILTON

General Offices: Philadelphia 42, Pa. • Offices in Principal Cities
In Canada: Peacock Bros., Ltd., Montreal, Quebec

P-A VENTURI GAS SCRUBBERS



Here's why ONE INSTALLATION leads to another

Repeat business is a sure sign of client satisfaction in any field. That's why the record of repeat installations of Chemico P-A Venturi Scrubbers is impressive. Most Chemico installations currently underway have predecessors in the same company or in the same scrubbing field.

Multiple installations are presently in service scrubbing sulfuric and phosphoric acid mists, metallurgical dusts and many other of the *more difficult* fumes encountered in the chemical industry.

If you have a serious air pollution or waste recovery problem not in our experience file, we will be glad to send one of our experienced engineers to make reliable pilot tests at your plant with our portable equipment.

1. *Low capital cost*

WHY are capital costs low?
Because of simplicity of design.

2. *Low maintenance expense*

WHY are maintenance costs low?
Because there are no complex accessories required to maintain units at top performance levels.

3. *High collection efficiency*

WHY are collection efficiencies so high?
Because the patented feature of the P-A Venturi induces a high degree of particle agglomeration.

Phone (MU 8-7400) or write our P-A Sales Dept. for further information and ask for our Bulletin M-102 on P-A Gas Scrubbers.

CHEMICO

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

Technical Representatives Throughout the World • Cables: Chemiconst, New York

CC-250

Lapp Valves are Solid Porcelain

You need to make no compromise with contamination or corrosion from valves in chemical processing. Lapp valves are of *solid* Lapp Porcelain, a material unique as a ceramic for industrial scale chemical service. It alone offers the following combination of characteristics and qualities:

PURITY • Lapp Porcelain is a potassium aluminum silicate, made from selected clays, flint and feldspar...has no free iron or other metallic impurity.

NON-POROUS • Complete vitrification of all sections, through firing to 2300°F., provides *zero* porosity. No dye penetration of body in 100,000 psi test. No chemical can penetrate in service.

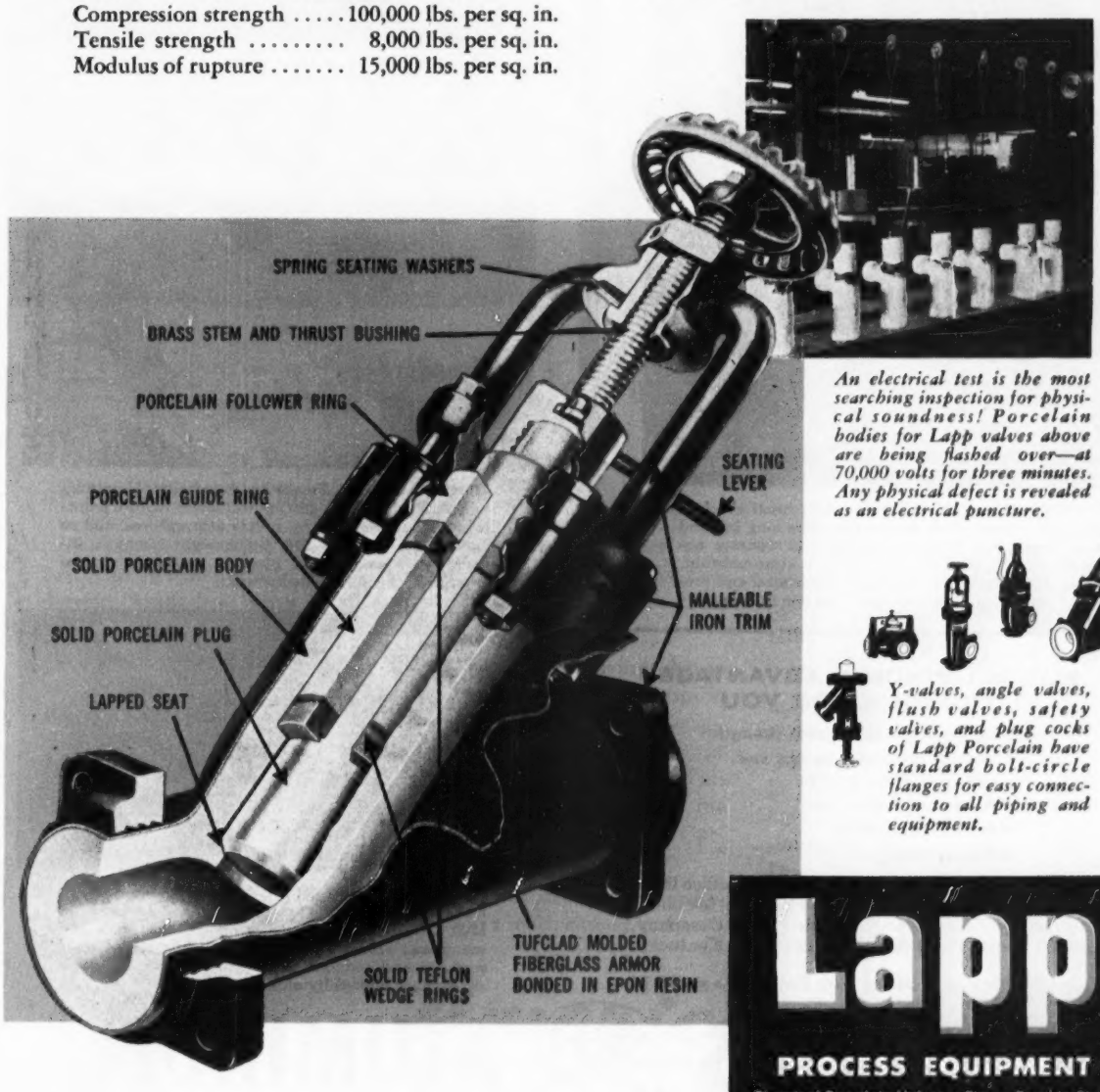
HIGH MECHANICAL STRENGTH

Compression strength ..... 100,000 lbs. per sq. in.
Tensile strength ..... 8,000 lbs. per sq. in.
Modulus of rupture ..... 15,000 lbs. per sq. in.

CHEMICAL RESISTANCE • Lapp Porcelain is unaffected by any acids except HF. It provides years of trouble-free service, handling hot acids in all concentrations, as well as mixed acids and other troublesome combinations.

UNIFORM QUALITY • Lapp Porcelain has been manufactured for 38 years for use in most severe chemical, electrical and mechanical services. Plant facilities include Lapp-patented vacuum processing, deaerating pug mills, two continuous tunnel kilns, and complete chemical, electrical and mechanical test equipment.

Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 307 Wendell St., LeRoy, N. Y.



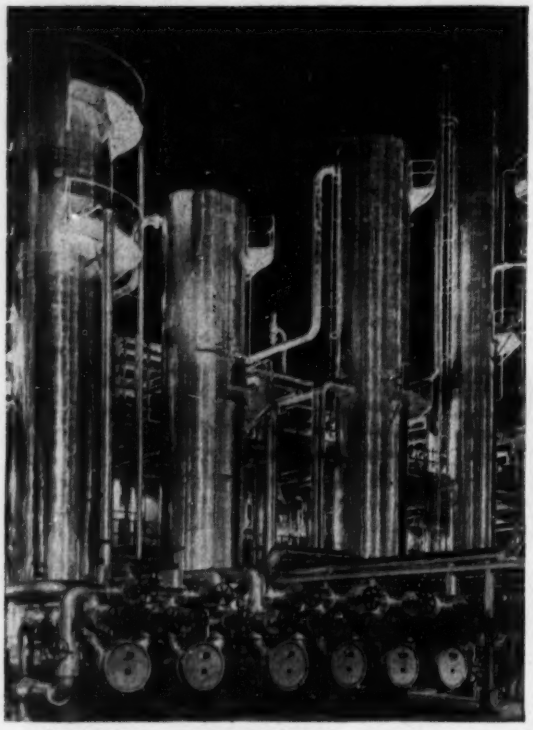
An electrical test is the most searching inspection for physical soundness! Porcelain bodies for Lapp valves above are being flashed over—at 70,000 volts for three minutes. Any physical defect is revealed as an electrical puncture.

Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment.

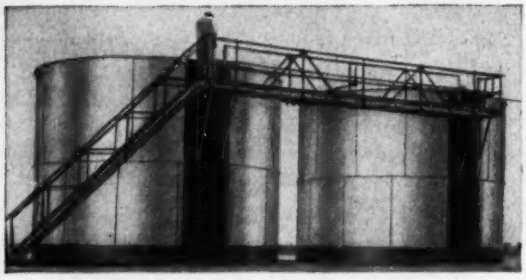
Lapp
PROCESS EQUIPMENT
Chemical Porcelain Valves • Pipe • Raschig Rings
Pulsafeeder Chemical Proportioning Pumps

SEE HOW ALUMINUM CAN CUT YOUR COSTS!

These are a few of the many products that save money by lowering maintenance and increasing efficiency in chemical and petroleum processing plants. Reynolds does not make these products . . . but Reynolds Aluminum is used by the manufacturers who do. We'll furnish their names on request.



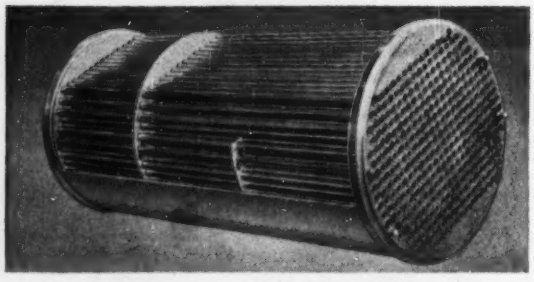
Insulation and vessel jacketing: Aluminum sheet in single layers over bulk insulation offers long life and maintenance free protection. Applied in separate layers, aluminum provides lightweight, moisture resistant, heavy duty insulation. Aluminum insulated and protected plants look better longer with less upkeep.



Aluminum Tanks and Tank Decks: You can now eliminate maintenance and costly corrosion damage with aluminum tanks and containers for nitrogen solutions, oils, acids, hydrogen peroxide and many other corrosive fluids. End expensive replacement of decks and supports by installing aluminum roofs and upper sections in sour crude storage.



Aluminum Gratings, Treads and Handrails: Aluminum installations like this grating will never require painting, are not damaged by sulfide atmospheres, and as a result, give longer life. Lightweight strength, installation economy and pleasing appearance make aluminum the preferable material.



Aluminum Heat Exchanger Tubing: Costs less and lasts longer. Aluminum tubing is widely used for H_2S, CO_2, NH_3, hydrogen peroxide, oils, acids and many wax products. High heat transfer, non-fouling surfaces and reduced maintenance costs are other advantages offered by aluminum.

PUT ALUMINUM'S ADVANTAGES TO WORK FOR YOU

- Light weight with great strength
- Natural resistance to rust and corrosive atmospheres
- Attractive appearance
- Ease of fabrication
- Non-sparking

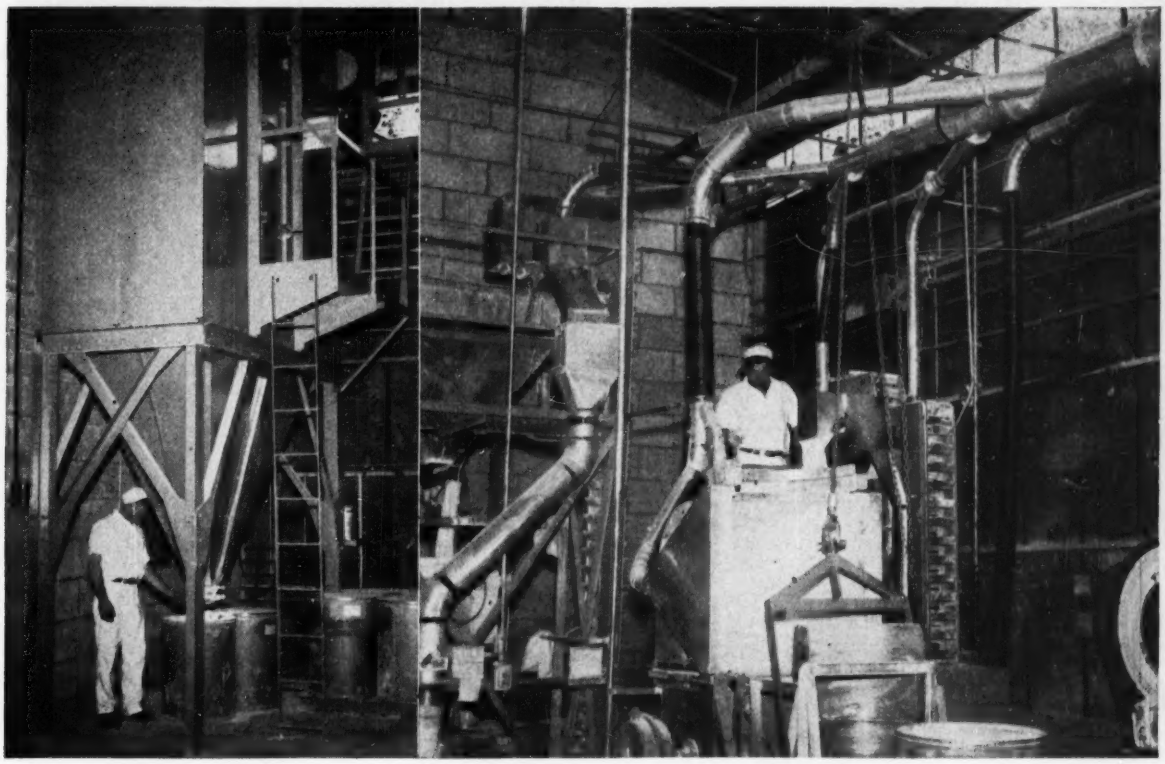
For more information call the Reynolds office listed under "Aluminum" in your classified telephone directory. Or write to Reynolds Metals Company, 2567 South Third Street, Louisville 1, Kentucky.

See "Mister Peepers", starring Wally Cox, Sundays on NBC-TV.

REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

pioneering developments keep **DUSTUBE®** *first in dust control*



DUSTUBE® Takes A Powder and Cures A Headache

Product Savings Pay For Dust Control at The Norwich Pharmacal Co.

Aspirin—a sure relief for most headaches—creates throbbing production "headaches" when in the form of dust it escapes into the atmosphere from tableting processing operations. At The Norwich Pharmacal Co. this dusty condition presented three major problems: operator health and comfort; substantial loss of product as dust; equipment damage and wear.

The "headache" created by this dust problem was completely cured with the installation of a Dustube cloth-tube-type Dust Collector system resulting in these benefits:

1. The financial savings due to collection and reuse of the aspirin and starch dust, which was originally lost, represents about 1% of the total material handled. This saving is sufficient to pay for the Dustube Collector in a short period of time.

2. The department is maintained in a much cleaner and neater appearing condition. Working conditions were immeasurably improved.

3. The wear and other difficulties due to dust settling in the operating machinery were greatly reduced.

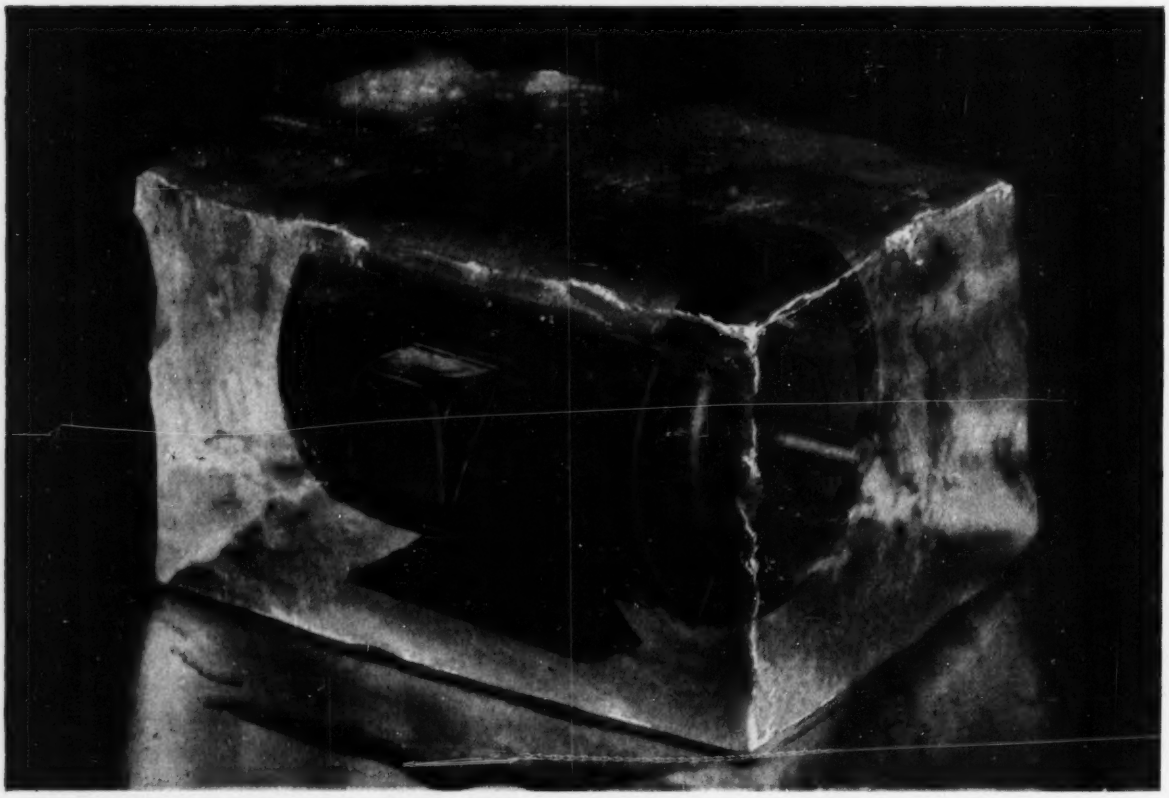
Your dust or fume "headache" may be different, but a Dustube Collector can cure it, too. In almost every type of industry—in plants similar to yours—users have found the high efficiency, simplicity, and economy of the Dustube a difficult combination to equal for top performance. Write today for full details.



Write for your copy of Catalog 372 today.

American
WHEELABRATOR & EQUIPMENT CORP.
347 S. Byrkit St., Mishawaka Ind.

dustube®
COLLECTORS



Let this unique illustration convey to you the remarkable cooling effect of Howell's new internal ventilation system in Series 100 Motors.

New Howell re-rated motors run cooler... last longer

Your motor needs have changed just as your machines have changed. Here are *completely new* motors . . . designed and built to meet *today's* requirements!

Now! Howell brings you everything you want in a re-rated motor: smaller size and lighter weight . . . plus *better cooling* for less maintenance and longer life.

Howell Series 100 re-rated motors feature a new internal ventilation system that provides 50% more contact between cooling air and active lamination materials. Temperature ratings are easily maintained; overload capacity is increased.

Many New Features

Series 100 Motors offer many other advantages: *They take up less space* – up to 30% less in some sizes; both open and totally enclosed fan-cooled motors have same diameters. *They perform better* – Howell uses dependable copper rotors for higher conductivity, greater flexibility; new Mylar* slot insulation is thinner (more space for copper windings), yet eight times stronger. *They last longer* – better cooling, double-shielded bearings and super tough steel frames and feet, with cast iron endplates, insure extra years of trouble-free performance. *They fit your special needs* – Howell provides rotors in three diameters for each frame size; corrosion-resistant materials and fittings are available to meet your specific industry problems.

Before you buy any re-rated motor, compare Howell Series 100 Motors for modern design, outstanding performance, and engineered precision. Howell will continue to make a complete line of regular and special motors – we have in our files more than 20,000 electrical design specifications! Let us serve you. Call your Howell man today.

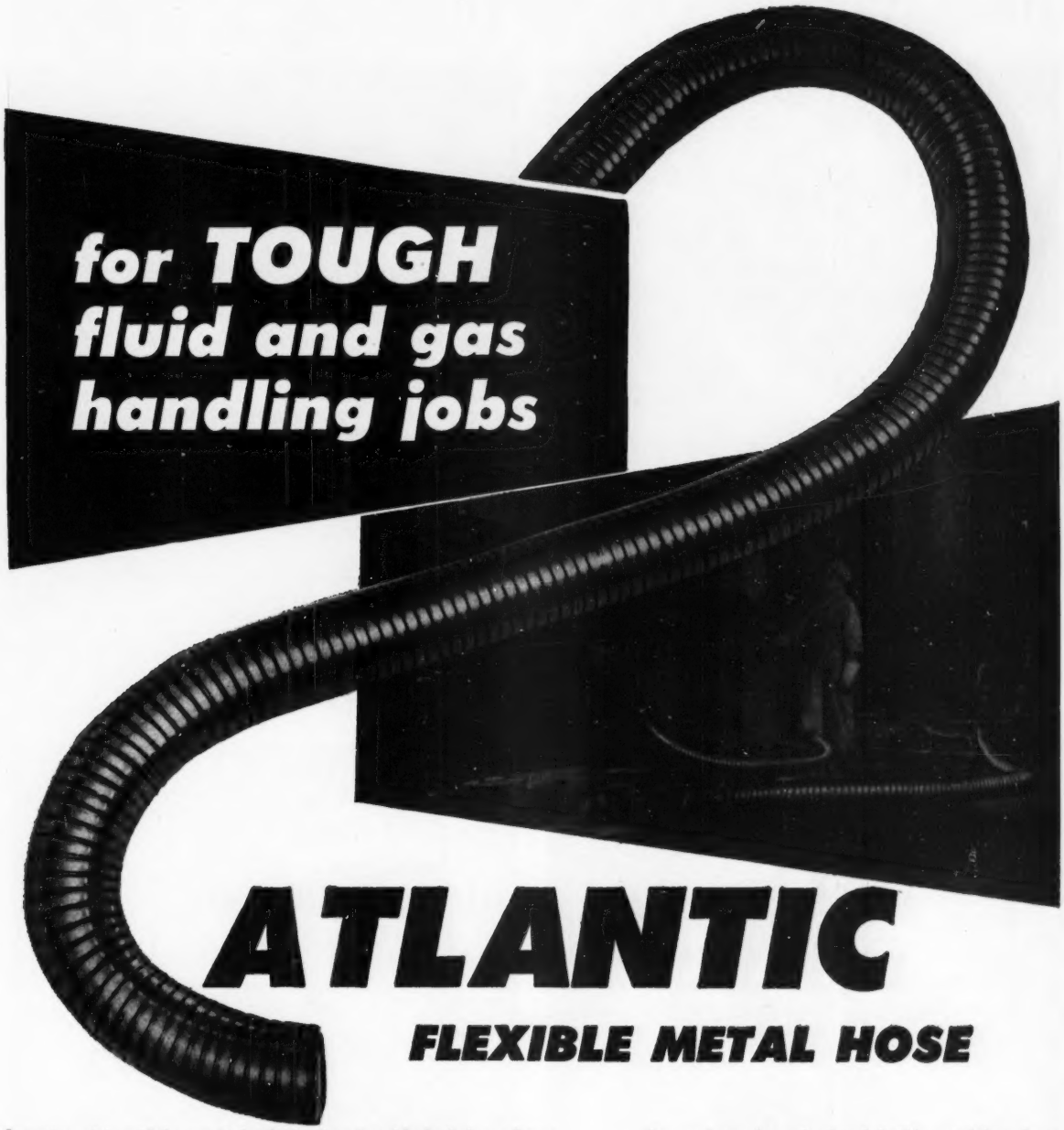
*DuPont trade mark

HOWELL Red Band MOTORS

HOWELL MOTORS

Howell Electric Motors Company, Howell, Michigan

MOTORS FOR INDUSTRY SINCE 1915



ATLANTIC

FLEXIBLE METAL HOSE

Conveying nitric acid for use in batch nitrations is quick death for ordinary flexible metal hose. Sulphuric acid and plating solutions are other notorious killers. When temperature and pressure extremes and adverse handling conditions are also involved, hose replacement is frequent and expensive.

That's why—for tough jobs—it's good economy to specify Atlantic flexible metal process hose. Manufactured to survive the most destructive use, it is unequalled for leak-proof qualities, flexibility, durability, strength and lightness. It performs long after ordinary hose is scrapped and returns real savings in your material and labor dollar.

Whatever your application — conveying, controlling movement and vibration, correcting misalignments, compensating for expansion and contraction — *there is an Atlantic flexible metal hose that is best for it.*

Available in Seamless or Interlocking construction: Steel, stainless steel, monel, bronze. ⅛"—36" I.D. inclusive with appropriate fittings.

Our engineers have developed flexible metal hose for a number of classified nuclear applications. Though these types cannot be released at present, the experience gained is available for any unusual problems you may have.

Write for Chemical and Process Industries Bulletin 20D.

See our Catalogs in Sweet's Files for Product Designers and Mechanical Industries.



ATLANTIC METAL HOSE CO., INC.

329 Dyckman St., New York 34, N. Y

How would YOU solve these two problems?



1. OVERDONE X-RAYS WON'T DO. Water in developer tanks for X-rays must be kept at exactly 68°F — otherwise negatives come out over or underdone. The thermostat in the developer tank used by Johns Hopkins Hospital was subject to corrosion. Replacement with a stainless steel Fenwal THERMOSWITCH® unit solved the problem. It's accurate, won't corrode, lasts indefinitely since activating element is completely enclosed.



2. WHERE THERE'S A SMOKEHOUSE, there shouldn't be a fire hazard. Sawdust heated in the "smoke producer" used by Albert F. Goetze, Inc., meat packers, can easily break into flames. When this happens, a sensitive, quick-acting Fenwal THERMOSWITCH unit shuts down the blowers carrying the smoke to various curing rooms. Absolute reliability in the control unit assures maximum smoke without endangering the property.



3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.



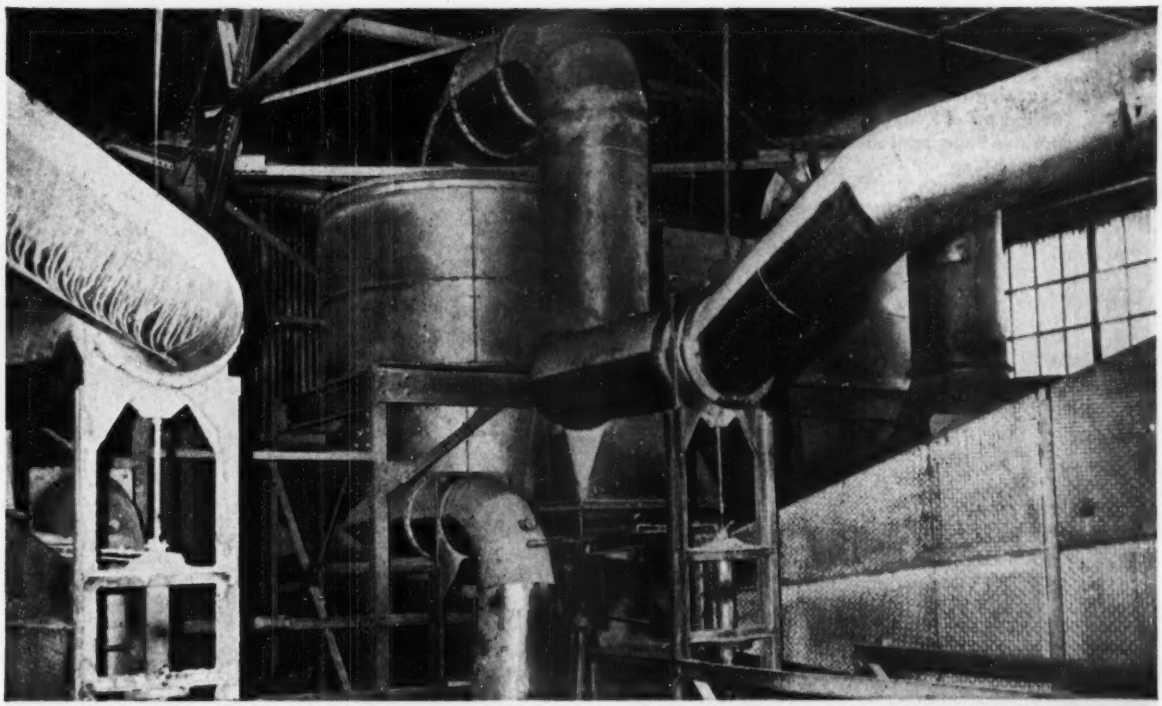
4. SEND FOR THIS CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. **Write Fenwal Incorporated, 1610 Pleasant St., Ashland, Massachusetts.**

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

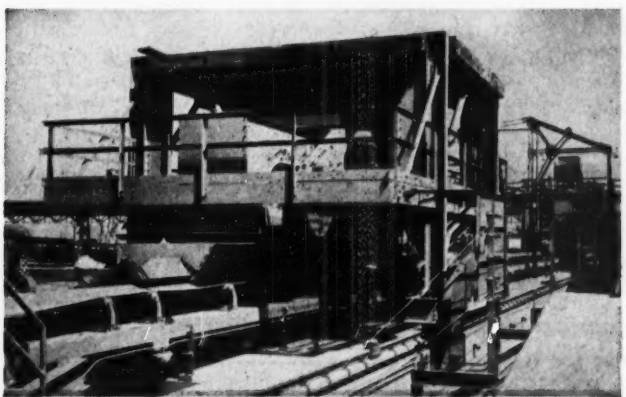
SENSITIVE . . . *but only to heat*



These flues and dust collectors are part of the refining plant of Aluminum Co. of America, at Mobile, Ala., where alumina is separated from bauxite. Furnace temperatures in the plant subject interior equipment to 350°F. heat; caustic dust and fumes are severe. Despite these rough conditions, paint on the interior equipment is in good condition and has been renewed only once since 1938. A formulation based on BAKELITE Phenolic Resins, pigmented with aluminum, is used and, according to the plant superintendent, "lasts better than anything they have found."

350°F. HEAT-CAUSTIC FUMES

and equipment coating that really stands up



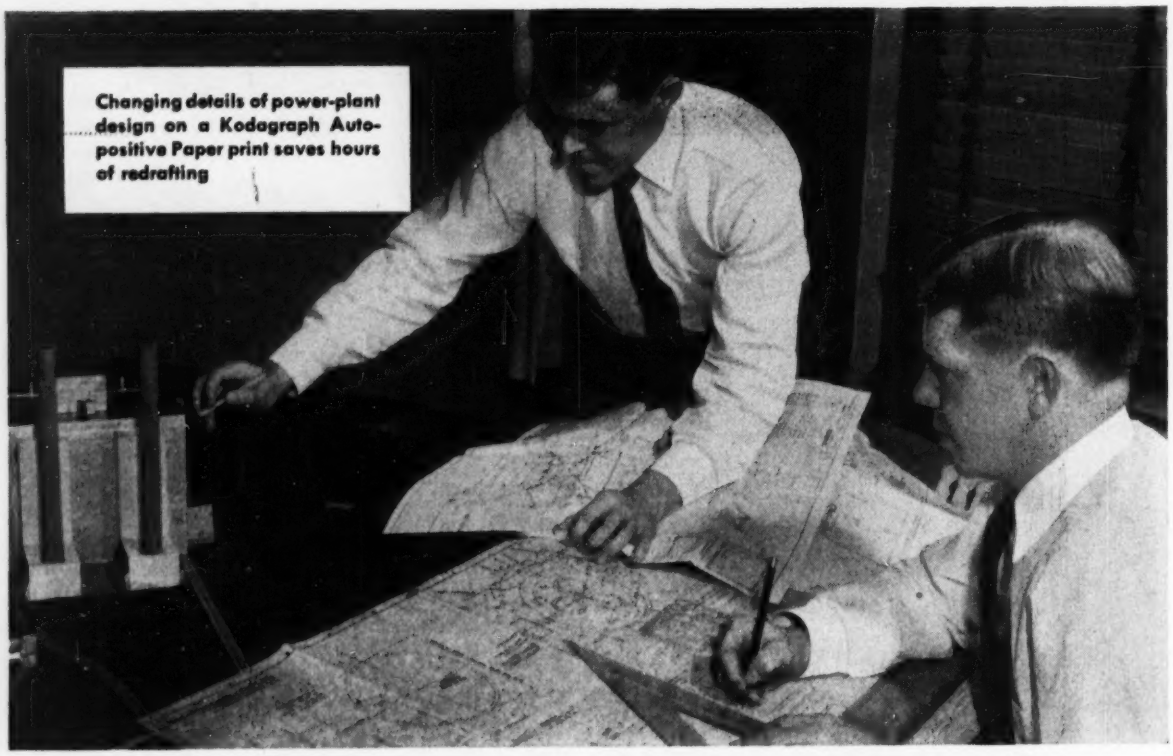
Aluminum paint based on BAKELITE Phenolic Resins also keeps this refinery's exterior equipment in excellent condition. A new coating is given about every five years. Of course, the same formula is used. Coatings for both interior and exterior work were formulated by **Mobile Paint Mfg. Co., Inc.**, Mobile, Ala.

If you wish to provide buildings, equipment, or products with long-lasting protection against corrosives, temperature extremes, industrial atmosphere, and hard usage, there are many specialized coatings based on BAKELITE Resins available from coating formulators. Results in just about every type of industry and location, and under a very wide range of service extremes provide an experience record that thoroughly justifies their selection. Our booklet, "BAKELITE Resins Coatings for General Industry," shows numerous applications. For a free copy write Dept. XM-46.

BAKELITE
TRADE-MARK
Phenolic, Vinyl, Styrene
RESINS FOR COATINGS

TRADE MARK

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.



Changing details of power-plant design on a Kodagraph Autopositive Paper print saves hours of redrafting

Toledo Edison Company reports on its use of Autopositive—

"One saving after another since 1947"

Shortly after Kodagraph Autopositive Paper was introduced, the Toledo Edison Company, Toledo, Ohio, began exploring its possibilities for engineering drawing reproduction.

Here was a revolutionary photographic intermediate paper which produced positives directly from positives—no negative step. It could be exposed in standard print-making equipment . . . processed in standard photographic solutions. *Entire operation in ordinary room light, too.* Jobs which had been difficult and costly became easy and economical—Kodagraph Autopositive Paper costs only a few cents a square foot. Some typical savings at Toledo Edison *which you can duplicate* are listed here.

☐ **Old prints and intermediates reclaimed.** No time lost retracing. Autopositive Paper strengthens weak line detail, cleans up backgrounds. Toledo Edison now can get intermediates which have dense photographic black lines on an evenly translucent paper base. *Original quality or better!*

☐ **Opaque originals no problem.** Many of Toledo Edison's forms, charts, operating maps, etc., are on opaque stock—some two-sided. Data is added to these in pencil or by typewriter. Then Autopositive reproductions are made and used to produce the direct-process prints needed for distribution. The 1954 Annual Budget, for example, was reproduced in this manner. *Autopositive saves time and dollars for all departments.*

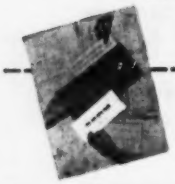
☐ **Print-making simplified.** Toledo Edison runs Autopositive intermediates at uniform, practical speeds in its direct-process machine . . . gets sharp prints time after time. *Autopositive lines do not smear, smudge, or lose density.*

☐ **Drafting shortcuts.** An Autopositive print is made of a drawing which has to be altered. The obsolete detail is eradicated or scissored out, and another Autopositive is made. New design is then added, and the job is completed without redrafting.

☐ **Photo-lasting file copies.** Toledo Edison also finds that Autopositive intermediates will not turn yellow or become brittle . . . are ready to produce sharp, legible prints whenever needed.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction



Shows all the ways you can save with Kodagraph Autopositive Paper.

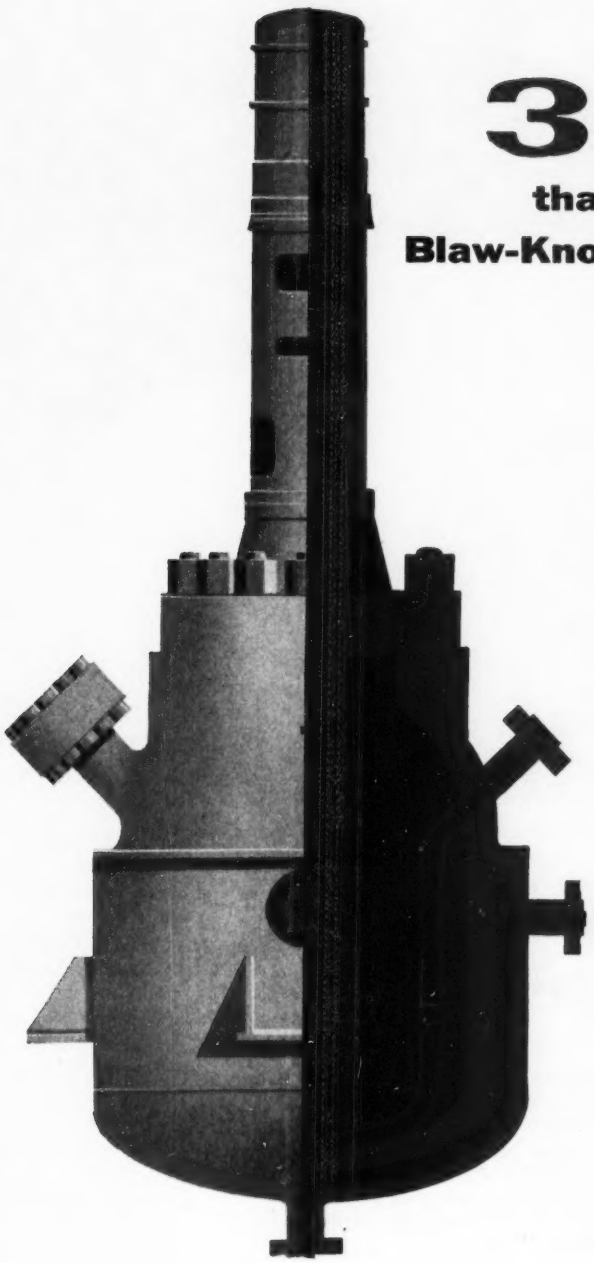
MAIL COUPON FOR FREE BOOKLET

EASTMAN KODAK COMPANY 105
Industrial Photographic Division, Rochester 4, N. Y.
Gentlemen: Please send me a copy of "Modern Drawing and Document Reproduction."

Name_____ Position_____
Company_____ Street_____
City_____ Zone____ State_____

Kodak

engineering knowledge
fabricating skill
facilities...



3 important factors that make Blaw-Knox Autoclave-Reactors more reliable

Few pieces of process equipment require as much of a manufacturer's engineering knowledge, fabricating skill and facilities as an autoclave-reactor.

High temperatures and pressures, varying operating conditions, corrosion, charging and discharging, agitating, heating, control and safety instrumentation—all are important considerations.

- When you buy a Blaw-Knox Autoclave-Reactor you draw upon the *engineering knowledge* of specialists in each of these important phases of autoclave-reactor design.
- For the construction of your autoclave-reactor, you can depend upon the *fabricating skill* of men responsible for the one factor upon which the Blaw-Knox reputation is built—quality.
- Blaw-Knox *facilities* include seven large modern plants which specialize in the fabrication of ferrous and non-ferrous equipment, piping, and the production of heat and corrosion-resisting castings.

These are important factors to consider in the specification of an autoclave-reactor. They are the factors that make Blaw-Knox Autoclave-Reactors more reliable.

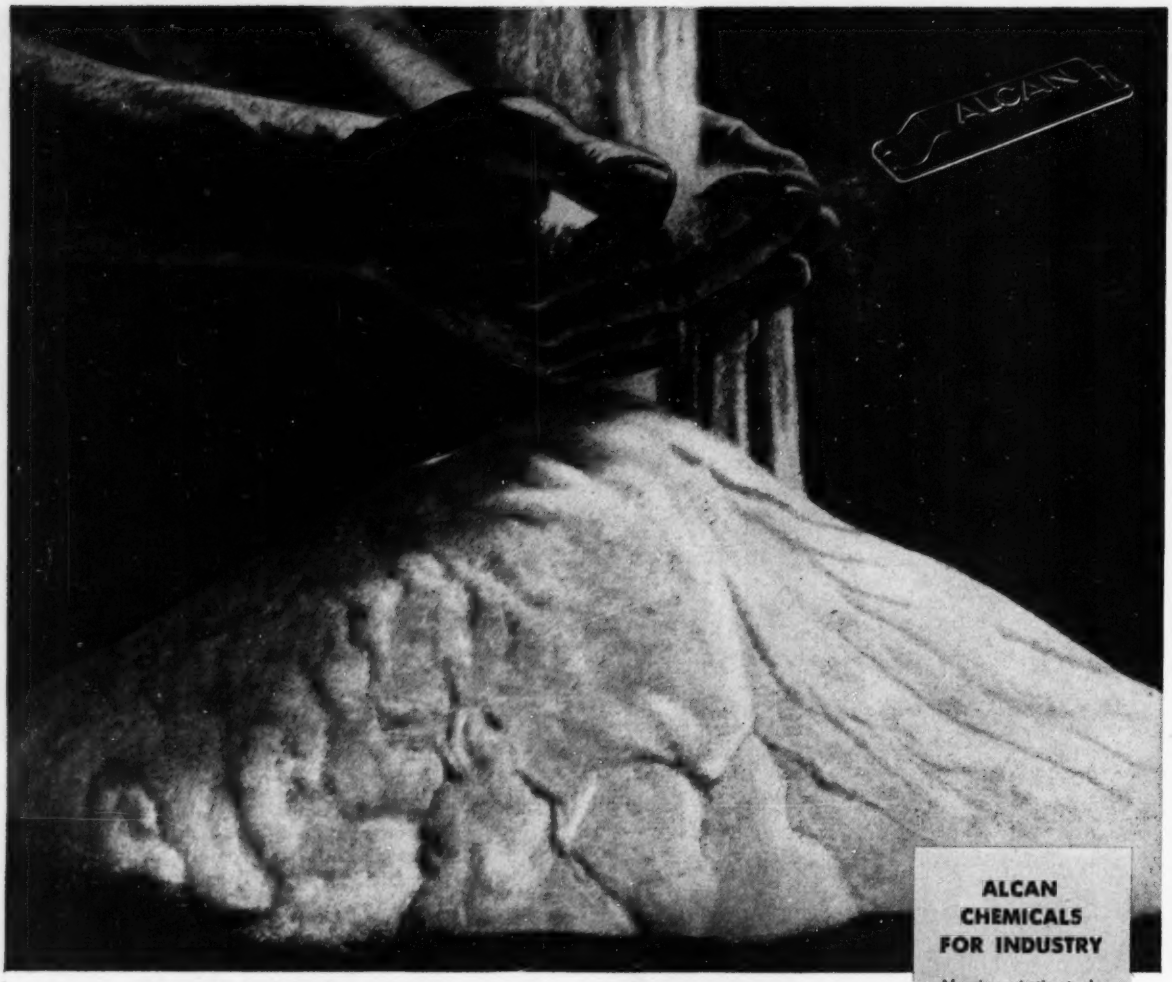
Blaw-Knox builds autoclave-reactors in any capacity, for any pressure, temperature or reaction. When you buy, be sure to specify Blaw-Knox.

Write for catalog 2413.

BLAW-KNOX

BLAW-KNOX COMPANY

Blaw-Knox Equipment Division
Process Equipment Department
Pittsburgh 38, Pennsylvania



ALCAN CHEMICALS FOR INDUSTRY

- Alumina, Activated
- Alumina, Calcined
- Alumina Hydrate
- Aluminum Chloride, Anhydrous
- Aluminum Fluoride
- Aluminum Sulphate
- Bauxite
- Chlorine, Liquid
- Cryolite, Artificial
- Fluorspar
- Lime
- Magnesia
- Magnesium Chloride, Anhydrous
- Sodium Fluoride
- Sulphuric Acid

What's Alcan doing *in Chemicals?*

As THE PRODUCER of one-fourth of the free world's aluminum, Alcan (Aluminum Company of Canada, Ltd.) is concerned with chemicals in a big way. With a large range of metallic and non-metallic products, evolving from the production of aluminum, Alcan is in a position to supply chemicals to industry for a variety of uses.

These Alcan Chemicals *have* to be good—and you can depend on it—they are. Co-operating in their production are Alcan's sister companies. Each of these affiliates specializes in its own field of endeavor:

- **Laboratory research, and the exploring and surveying of material resources throughout the free world;**
- **Mining and processing of raw materials in many different countries;**
- **Development of up-to-date shipping methods for the protection and speedy delivery of the products.**

One of Alcan's sister companies, Aluminium Limited Sales, Inc., distributes Alcan Chemicals in the United States. The office near you will be glad to help you with your special chemical requirements.

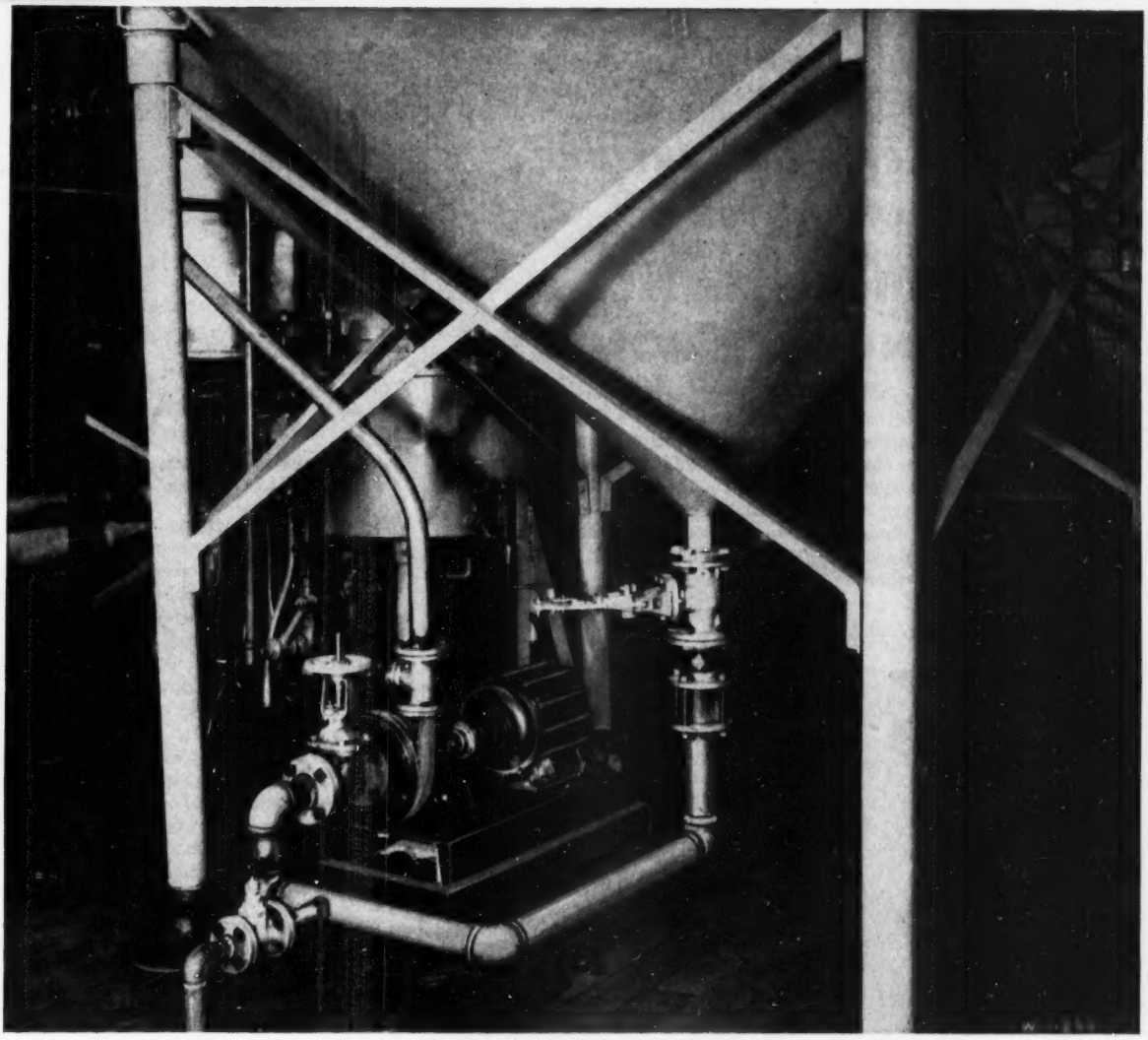
ALCAN Aluminum Chemicals

ALUMINIUM LIMITED SALES, INC.

One of the **ALUMINIUM LIMITED** group of Companies

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Cable: ALIMPORT

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MOTHER LIQUOR and naphtha are pumped from separating tank to neutralizer tank by a 1½" Worthite pump, one of many at the Bayer Aspirin plant in Trenton, N.J.

No pumping headaches at Bayer Aspirin

With millions of aspirin tablets to turn out daily, the Trenton, New Jersey, plant of the Bayer Company can't afford many headaches over pumping.

As a matter of fact, they don't have *any*. For more than seven years, their corrosion-resistant Worthite pumps have been handling every solution in the aspirin-making process — acetic anhydride, naphtha, benzol, and all resultant liquors — without a sign of trouble.

If you've got a pumping problem involving corrosive fluids, chances are you'll find the answer in a Worthite pump. Get all the facts on these rugged units by writing for Bulletin W-350-B16 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. C-4.4

WORTHINGTON

Type CNG Worthite Chemical Pump • **SESC (Standard End Suction Centrifugal)** • **Type KEB Worthite Propeller Pump**

Sizes ¾ to 6". Capacities to 2000 gpm; heads to 200 ft.

General Service Pumps CNF, CNE, CNR. Capacities to 2600 gpm; heads to 550 ft.

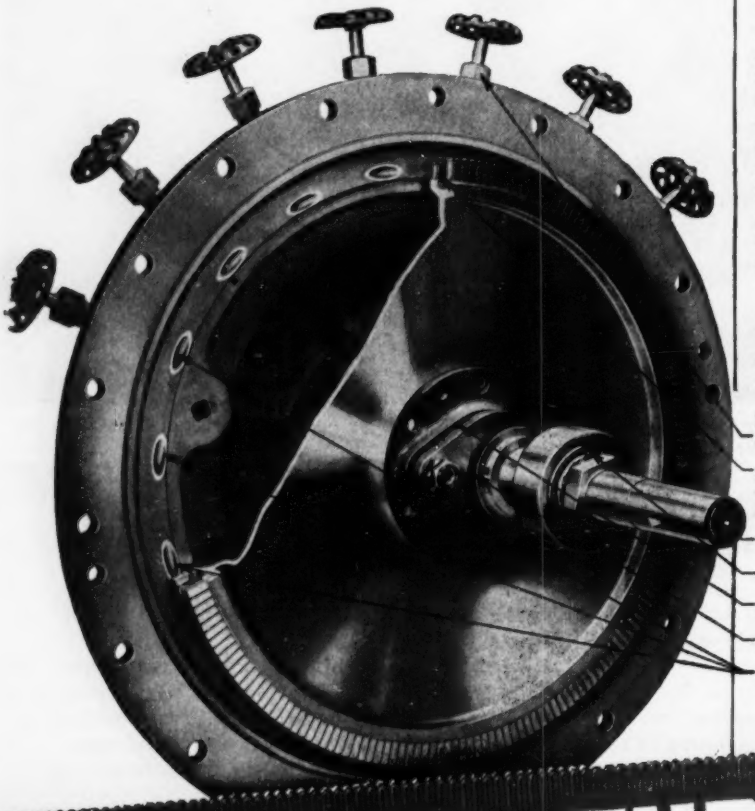
Sizes 8 to 24". Capacities to 19,500 gpm; heads to 20 ft.

SEE US IN BOOTHS 147-149 AT THE NATIONAL CHEMICAL EXPOSITION INC.

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



7 hand valves for efficient partial load operation, (20" turbine shown)

2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced

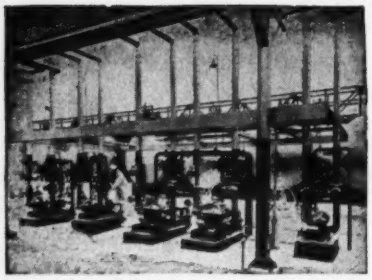
30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

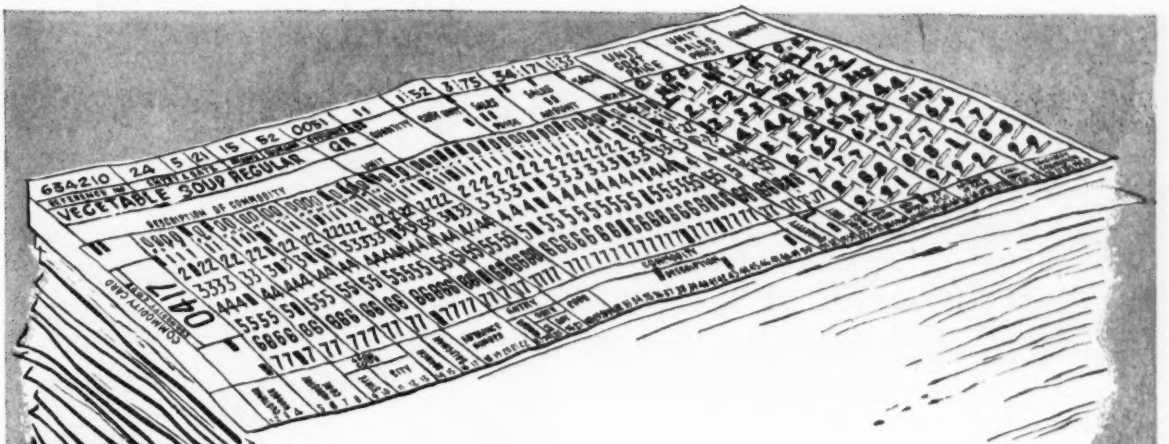
MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP.,
230 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES



What happened to these punched cards shouldn't happen to a process...

On humid days paper becomes limp. It expands and, in the case of punched cards, may jam machinery. Instant coffee can absorb humidity enough to jam packaging machines. Sugar and powders gum up and are unworkable. Any number of processes bog down when humidity is high.

Materials that readily absorb humidity and retain moisture are hygroscopic. They can give you trouble on a "wet day" unless you extract humidity from the air around them. Lectrodryers are doing this in many industries every day . . . making processes workable in any kind of weather.

10% relative humidity isn't uncommon with these machines. They can handle air in sufficient volumes to dry an entire warehouse.

If humid days frequently delay or stop your processes, inquire about Lectrodryers. Write for the booklet *Because Moisture Isn't Pink*. It describes the many ways industries are using Lectrodryers. Pittsburgh Lectrodryer Corporation, 303 32nd St., Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U. S. PAT. OFF.

Rigid testing of *Explosion-Proof* CONDULETS*

assures safety and long dependable service

Crouse-Hinds extensive laboratories and modern manufacturing combine to give you top quality

Laboratory testing is one of the key operations in the production of electrical equipment of the highest quality. Crouse-Hinds laboratories are equipped with the latest scientific instruments and staffed with expert technicians.

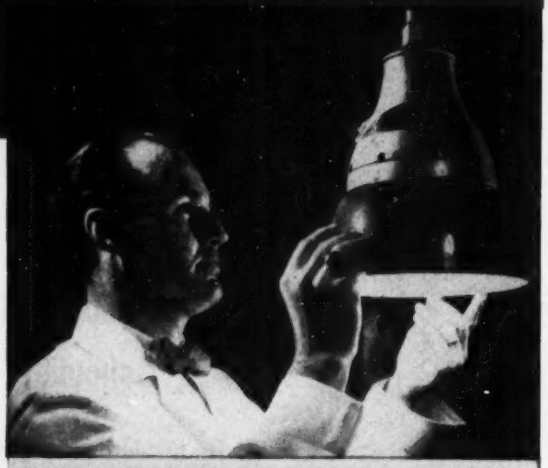
Products are constantly tested to make sure that they are being made to withstand field conditions. New devices are tested to predetermine their meeting or surpassing the requirements of Underwriters' Laboratories.

The photographs at the right show three of the many testing operations that are done in the Electrical Laboratory. It is equipped with apparatus for making both alternating and direct current tests, heat tests, pressure tests and many others.

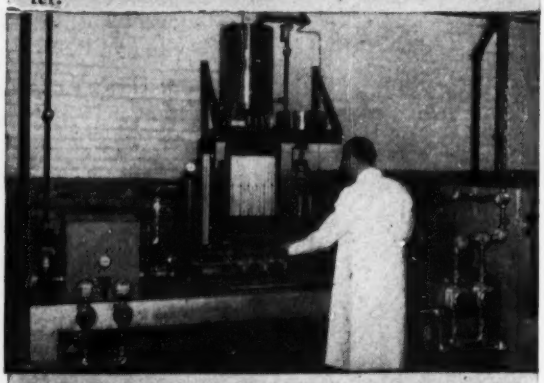
Close cooperation between Crouse-Hinds laboratories and manufacturing departments is one of the reasons why Condulets have been the "Standard of Quality" for nearly fifty years.

Specify CONDULETS on every job. They're made right... to serve you better... and last longer.

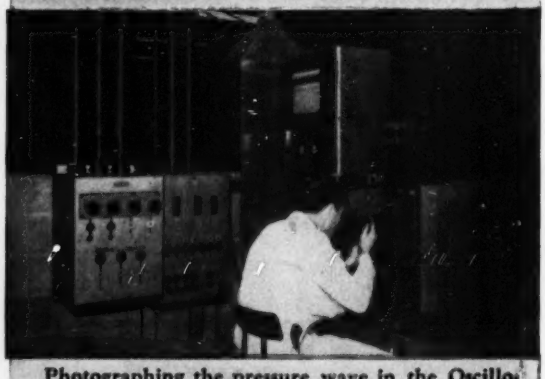
When quality counts
... you can count on Condulets



Probing for maximum exterior operating temperature on a Type EVA Explosion-Proof Lighting Fixture using a multiple point recording potentiometer.



Adjusting carburetors and flow meters to create a predetermined explosive mixture within an explosion-proof Condulet for an explosion test.



Photographing the pressure wave in the Oscilloscope to determine the maximum explosion pressure within an explosion-proof Condulet that is behind the concrete wall.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

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CONDUIT — First in the field — STANDARD OF QUALITY

*CONDULETS are made only by CROUSE-HINDS

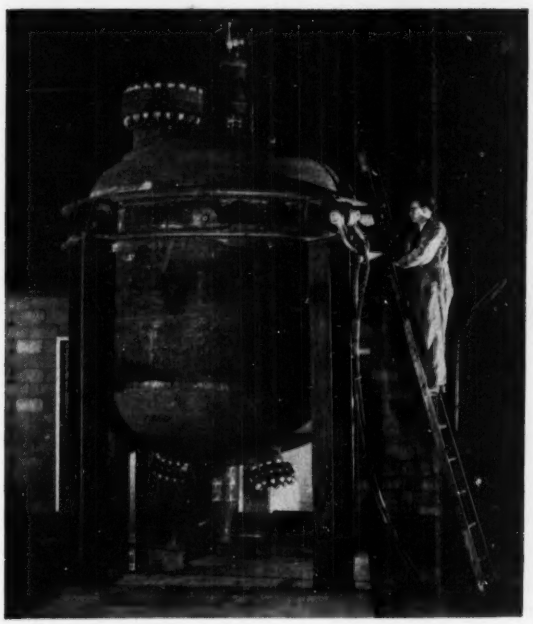
A Nationwide Distribution Through Electrical Distributors

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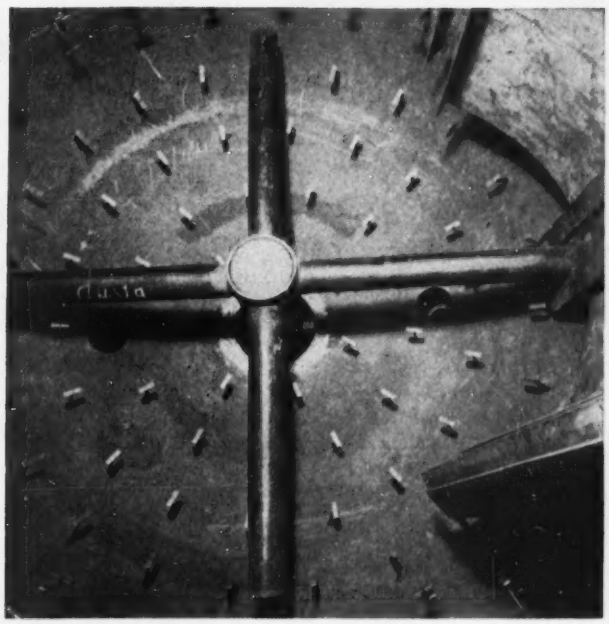


DEBUTANIZER—Looks small compared to the whopper at the foot of the page, but this is still a good-sized tower. Built to API and ASME codes, it is over 100 ft long, with 9/16-in. walls and 4-ft inside diameter.

WHAT'S NEW IN WELDED VESSELS



HEADING WEST—This chunky catalytic reforming reactor is bound for Oklahoma oil country. Built for rugged service—pressures to 726 psi; temperatures to 975 deg F—its shell is made of 2 9/16-in. plates, expertly welded, radiographed and hydrostatically tested.



COMPLEX INSIDES—Here's an unusual view that proves there's more to the vessel at the left than meets the eye. Note the stainless-steel shroud sections and spider arms, as well as a few of the 352 insulator studs, that added up to a mighty tricky fabricating job. Each of the reactors totalled 22 tons.



DEISOBUTANIZER

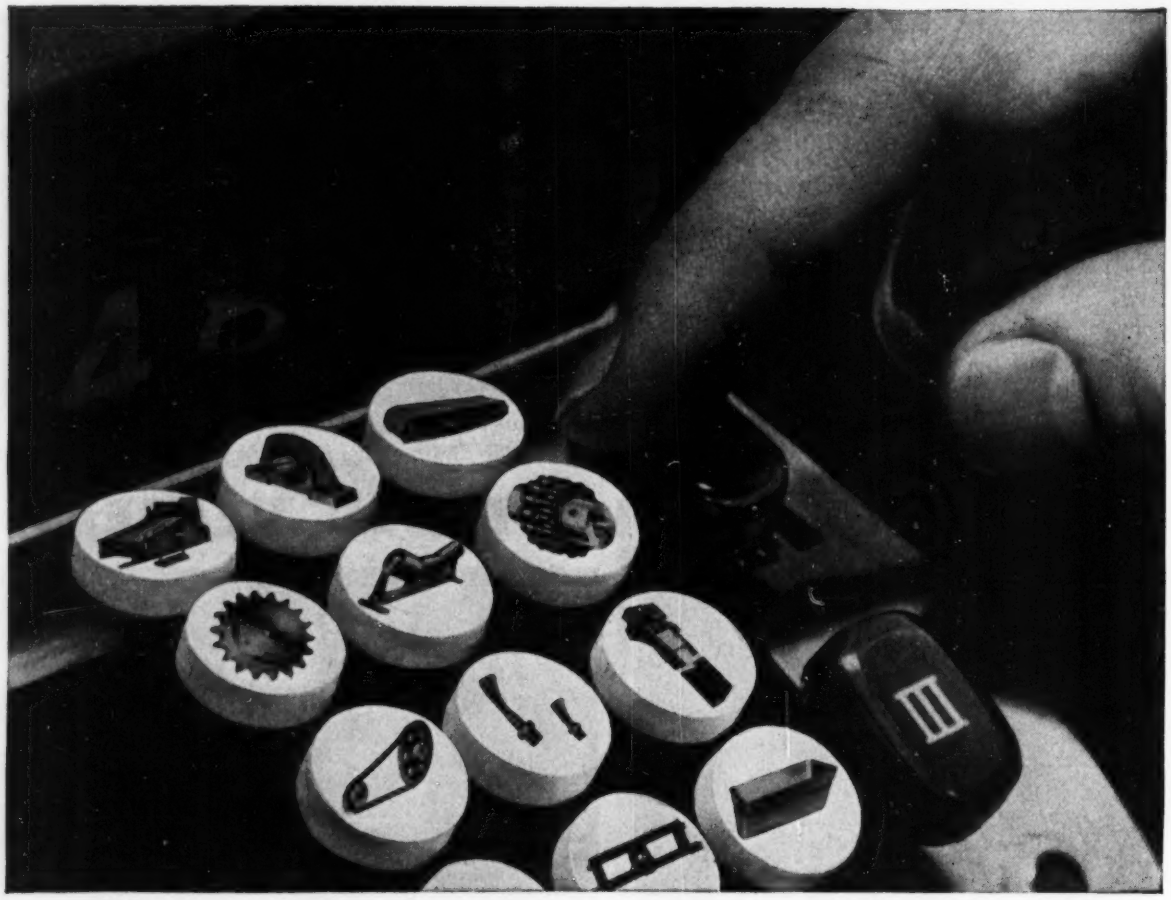
A long name for a long, long vessel. When erected at a refinery near Philadelphia this huge tower will stand almost 152 ft high. Its shell tapers from 1 in. to 13/16 and its inside diameter is 8 ft 6 in. Weight—87½ tons.

For further information about welded vessels, towers and other equipment for chemical and petroleum processing, call the nearest Bethlehem Sales Office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



Keyed...to your cost problems

One key that solves production and cost problems...that improves plant efficiency...is a fresh viewpoint, a new idea.

There's where the specialized services of your Chain Belt Field Sales Engineer can help you. His broad application knowledge...his familiarity with your problems...and the efficient performance of Chain Belt Products can help you find the right key to your problems.

for example: If "flooding" or "starving" of your belt conveyors is your problem, Rex Apron Feeders can assure that one right "key" to more economical and efficient operation. They closely regulate the flow rates of the material-handling system, substantially reducing costs.

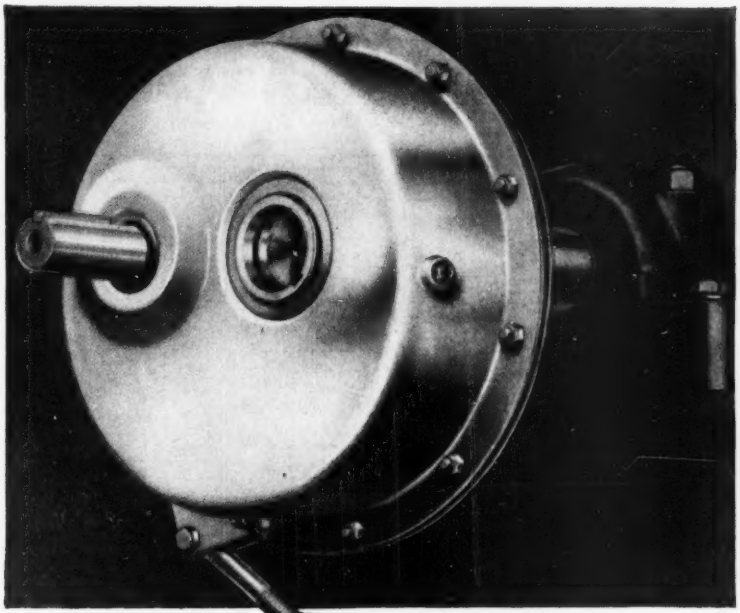
for example: If efficient bucket elevators are your needs, there is a size and type to exactly fit your operations. Rex Conveying Engineers will study your flow rates, materials handled, space requirements and recommend the elevator that will assure most economical operations.

for example: If you're having "belt idler troubles," there's an answer in the complete Rex Idler Line. Impact idlers that cushion loading shocks, self-aligning idlers that lengthen belt life, troughing idlers that cut maintenance costs, are a few of the many that can help you.

Whatever your needs...drive chain, conveyor and elevator chain, complete elevators, belt conveyors, feeders, roller bearings and transmission, buckets or sprockets, you'll relieve those production pains by looking to Chain Belt. See your local Field Sales Engineer or write direct to Chain Belt Company, 4648 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

District Sales Offices and Distributors in all Principal Cities



SIX SIZES

- 1/2 to 30 hp
- Single or double reduction
- Wide output speed range—420 to 10 rpm

FALK

ALL-STEEL

Shaft Mounted Drives—

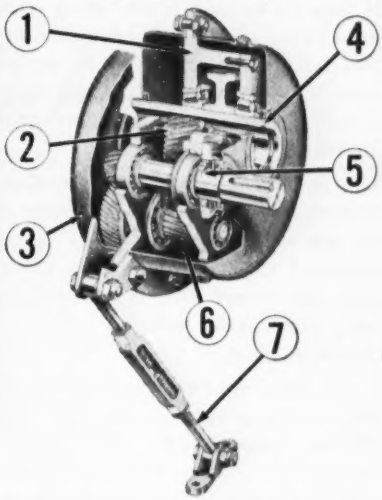
simple-compact-rugged-efficient

Created specifically for the vast number of applications demanding a sturdy and compact speed-reducing unit for direct mounting on the driven shaft, the new Falk all-steel Shaft Mounted Drive is built to give long service life at substantial savings of space, time, power and maintenance costs!

This efficient helical-gear drive, latest in the unmatched list of Falk precision-gearing achievements is an ingenious modification of the time-tested Falk Motoreducer design which has held, for more than 20 years, recognized leadership in this branch of highest-quality power transmission . . . It complements and completes the world-famous Falk line of reduction units covering the entire range of industrial applications.

Investigate the Falk all-steel Shaft Mounted Drive. Write to Department 247 for engineering bulletin, including selection and dimension details.

These famous FALK "In-built" factors *mean long life and dependability...*



1 **All-steel Frame,** with more than double the rigidity of iron, supports all rotating elements.

2 **Precision Helical Gears,** designed and machined by Falk, rated to AGMA standards.

3 **Pressed Steel Housings,** whose sole function is to keep oil in, dirt out; easily removed for gear inspection without dismounting unit.

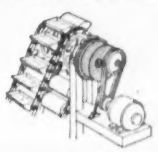
4 **Through Hollow Shaft** with counter bore provides for easiest installation or removal from driven machine shaft extensions.

5 **Backstop** can be furnished with the unit or added later for positive prevention of reverse rotation.

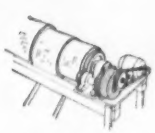
6 **Positive Lubrication,** continuous direct dip of revolving elements at all speeds.

7 **Tie Rod** and turnbuckle serve as anchor and facilitate V-belt or chain adjustment.

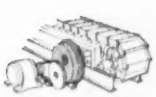
A FEW TYPICAL APPLICATIONS



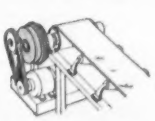
BUCKET ELEVATOR



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BELT CONVEYOR

THE FALK CORPORATION, Milwaukee 8, Wisconsin

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
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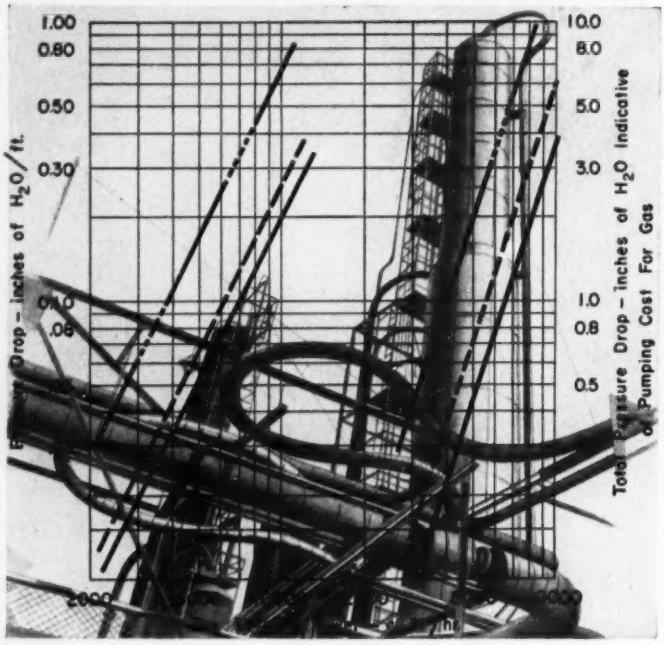
. . . a good name in industry

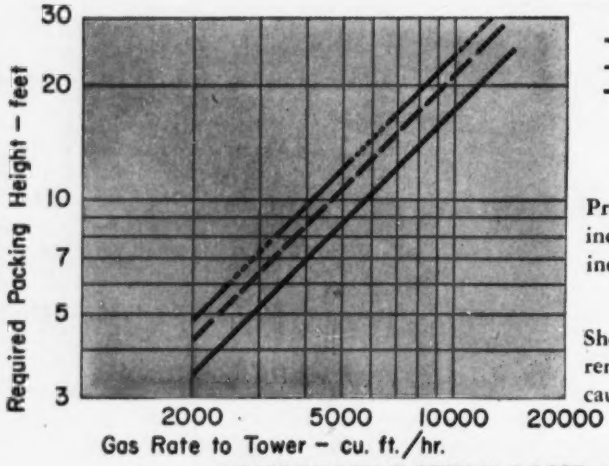
HOW INTALOX® SADDLES CAN REDUCE TOWER HEIGHT AS MUCH AS 30%

If your choice of a tower filling is based on what packing will, for an equivalent through put, be most economical in both initial tower investment and operating costs — take a look at these charts and their accompanying table.

This is another typical demonstration of the striking savings that can be made through the use of Intalox saddles. It is based on observed capacity data in a pilot plant operation where CO_2 is removed from an inert atmosphere using a dilute aqueous caustic solution.

It will pay you to analyze tower construction and operating costs in the light of greatly reduced tower height and weight. You'll quickly see why cost-conscious engineers are more and more frequently designing towers to use to the full pronounced advantages of Intalox saddles.





1" RASCHIG RINGS
1" BERL SADDLES
1" INTALOX SADDLES

Chart No. 1 (Above)

Pressure drop data comparison. Data shown both in inches of H_2O per foot, and total pressure drop in inches of H_2O.

Chart No. 2 (Left)

Showing comparison of packed height required for removal of CO_2 from an inert atmosphere using dilute caustic liquor as the scrubbing liquid.

COMPARATIVE STUDY BASED ON DATA SHOWN ABOVE

	Tower Crossection, Sq. Ft.	Required Packed Height* Ft.	Packing Weight Lbs.	Weight of Steel Shell—3/8" Thick	Weight Packing & Shell Lbs.	Total Column Hold-up Cu. Ft.	Pressure Drop—Inches of H_2O**
1" Raschig Rings	1.0	12.0	480	672	1152	0.76	2.0
1" Berl Saddles	1.0	10.5	473	588	1061	0.68	0.77
1" Intalox Saddles	1.0	8.6	293	482	775	0.68	0.47

* To remove 90% of the CO_2 from the gas; initial gas composition being the same in all cases.
** For a gas flow of 5,000 cu. ft./hr. and essentially atmospheric operation.

UNITED STATES STONEWARE CO.
Process Equipment Division AKRON 9, OHIO
NEW YORK CHICAGO HOUSTON

OCTOBER
1954

Chementator

Edward T. Thompson

• Standard Oil Development will soon reveal details on the fluidized char adsorption process it's been pilot planting at Baton Rouge. The word is that it works best on difficult gas separations, such as hydrogen purification. There are no commercialization plans yet.

• There'll soon be a major user of the oxo process. Carbide and Carbon will start up a new unit at Texas City this month that will turn out 60 million pounds a year of oxygenated chemicals. First to emerge: isooctyl, primary decyl and tridecyl alcohols.

Sohio set to make nitrogen chemicals

After two years of intra-company wrestling, Standard Oil of Ohio has decided to get into the chemical business. Plans call for a $17 million plant to make 300 tons a day of anhydrous ammonia. About 200 tons daily will be further processed into 125 tons of urea, 60 tons of nitric acid and 200 tons of nitrogen solutions.

Location is still indefinite, but it will either be in Toledo or Lima, Ohio. Decision rests on whether readily available byproduct hydrogen from Lima's reforming operations offsets excellent water supply and waste disposal facilities at Toledo. Most observers are confidently predicting that Lima will get the nod.

With Sohio off and running, the only major oil company that's still resisting the siren call of petrochemicals is Socony-Vacuum. And even they may not be far behind.

Nine new catalytic reformers have just been scheduled, which, with four now under construction, will boost the company's cat reforming capacity to about 130,000 bbl. per day. When completed—in about two years—these units will put Socony in an excellent position for recovering hydrogen for chemical manufacture of its own.

Ion exchange moves into epoxidation

Du Pont has developed a new method for using hydrogen peroxide to epoxidize unsaturated fats and oils into a whole raft of chemical intermediates. Still in the experimental stage, it replaces the sulfuric acid catalyst normally used in such reactions with an acidic ion exchange resin. Since the resin doesn't attack the epoxy ring under reaction conditions, high epoxide yields result.

Epoxidation is essentially the insertion of an oxygen atom in a double bond to form a carbon-to-oxygen-to-carbon ring. Hydrogen peroxide is not strong enough to do the job alone and must normally be converted—in situ—to the peracid.

The Du Pont process does all this in one step with essentially no byproduct formation at temperatures from 115 to 175 F. And yields are high. When epoxidizing methyl oleate, for example, conventional processes give an epoxy oxygen value of about 4.0%—if you keep the temperature below 115 F. The resin technique achieves up to 4.7% epoxy oxygen.

If the process proves commercially successful, Du Pont expects it will be best used to make resin plasticizers and stabilizers, plus intermediates for insecticides, paints, varnishes and lubricants.

Flexible depreciation—a new tax phrase

For many chemical firms, the most important part of the omnibus tax revision that became law this summer is the new look given to depreciation policy. The faster amortizations allowed early in a plant's life will go a long way toward minimizing exposure to long term uncertainties.

Until now, unless you happened to be in a

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defense goal category, you've often had to depreciate new facilities on a straight-line basis (e. g., 10% of the gross investment per year for ten years). Now, though, you've got a number of optional methods, including the "declining-balance" method which allows up to twice the percentage rate of the old system to be applied to the plant's unamortized value for the year.

To illustrate: a plant costing $25 million, with an estimated useful life of ten years, would be written off at the rate of $2.5 million a year for ten years under straight-line depreciation. But with the declining-balance method, you can deduct $5 million (20%) the first year. In the second year the depreciated balance is $20 million so a $4 million deduction is allowed.

Thus in five years, about two-thirds of the original investment can be written off as against only half under the old rules.

And the actual cash savings in the first year will be substantial—52% (at the present tax rate) of the difference between the declining-balance and straight-line depreciation reserves. In the case above, the tax saving the first year would be over $1.3 million.

Of course under declining-balance you would never actually fully write-off your plant. But the law allows you to switch to straight-line depreciation at any time. In most instances this move would be most profitable in the seventh or eighth year (based on a ten year amortization) because at this point the unamortized balance is about the same by either method.

Major suspension PVC plant nearly ready

Official opening of General Tire's $6 million polyvinyl chloride plant in Ashtabula, Ohio, scheduled for Oct. 21, will mark the return to the American scene of the suspension polymerization process for PVC. Equally important, it's the first such plant designed and built here by an independent engineering firm—Scientific Design.

Until now, suspension PVC know-how was pretty closely held by such big producers as U. S. Rubber. SD, which also just completed a 15-20 million pound plant of this type in Europe, says they've improved on earlier processes by shortening the operating cycle to give more production per unit of equipment. Thus they've brought the product into a good competitive price position with that made by the more commonly used emulsion process.

Suspension PVC has long been known as a purer, more versatile product than the emulsion type. Now, with the cost problem apparently licked, its one major disadvantage is that the actual polymerization is a batch step, while emulsion PVC is easily made continuously.

In conventional emulsion processing, water, vinyl chloride monomer and several percent of emulsifying agents are polymerized. About 10% of the monomer doesn't react and is recycled. Usually the emulsion product is spray dried, leaving all processing chemicals in the final product.

The Scientific Design suspension process, as used in Europe (and presumably by General), needs less than 1% of suspending agent—polyvinyl alcohol—and catalysts—benzoyl, acetyl and lauryl peroxides. These are mixed with vinyl chloride monomer and water and polymerized—batchwise—in a jacketed reactor. Unconverted monomer (10%) is removed from the resulting suspension first, then the polymer—continuously—leaving most of the additives in the water. Wet polymer cake is finally air dried.

For certain specialty polymers, the emulsion process still has a definite edge. But for general purpose and electrical grade resins, SD feels its suspension technique is far more desirable.

Next step in the company's plans is to market a series of "package" suspension process designs for low-budget plants to make 4-15 million pounds of polyvinyl chloride annually. They estimate that nearly 500 of the country's smaller processors could use such designs to good advantage.

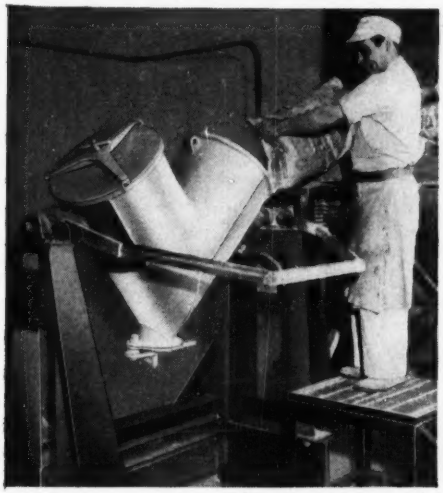
Hardwood—potential savior of newsprint

Almost anyway you look at it, the future of newsprint in the U. S. is tied inextricably to the chemical pulping of hardwoods, particularly those of the poplar family. Softwoods are now being overcut by about 20% and, with a predicted newsprint consumption rise from 6.1 million tons last year to 8.7 million by 1975, hardwoods offer the best chance for expansion.

That's the tenor of the latest Dept. of Commerce report to Congress on newsprint. While it makes no specific recommendations, the report does provide an excellent summation of what's being done by industry and government to lessen the dependence on woefully scarce softwoods, from which nearly all newsprint is now made.

At prevailing prices, hardwood pulpwood is considerably cheaper than softwood and you get more pulp per cord. But hardwood groundwood made by conventional mechanical means is weaker than softwood groundwood and requires addition

(Continued on page 110)



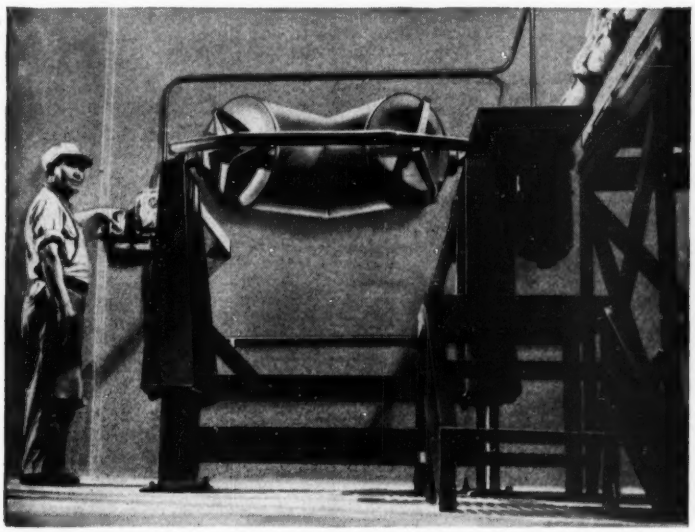
UNITED PRESS

Production worker Cruz Flores starts filling p-k twin shell blender with limestone flour. Pencillin drugs are also added, *then*...

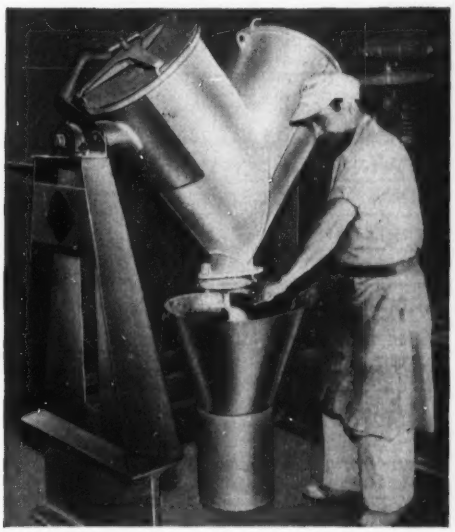
At the Los Angeles plant of Pillsbury Mills, Inc. . . .

p-k "pays the freight"

p-k Twin Shell Blender* mixes dry feed locally— cuts freight costs, ends delays.



After pushing starting button, Flores is free for other work until mixing is completed. Power consumption is low because of p-k's unique patented design. *Finally*...



Dust-tight slide valve is opened, thoroughly blended feed flows out freely from p-k's smooth, obstructionless interior.

When your blender gives a thorough mix, does it fast, and is easy to operate and maintain—then it's a cinch to "roll your own." In fact, sometimes it's even better! That's the conclusion of Pillsbury Mills, Inc., Los Angeles plant, and they know by experience.

Mixtures of anti-biotic-treated feeds were previously shipped west from the main plant in Iowa. "If there was a critical hold-up in deliveries," says Los Angeles plant superintendent Charles F. Wilson, "we faced a stalemate in operations. Moreover, there were freight costs. Now, with our p-k blender, all that is changed."

"The time and labor required to operate it is negligible," in Mr. Wilson's words, and both discharging and cleaning are equally easy. Absence of interior obstructions means free material flow, and "...we just haven't had any maintenance problems."

p-k twin shell dry blenders are continually making records in dozens of other fields—for speed, ease of operation, uniformity of blend. Send us a semple of your materials for a thorough blending analysis—or write today for fully illustrated Catalog 12.

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PROCESS CHEMICALS in Check Baker for these

Baker can supply these LIGHT METALS (or cations) IN THESE FORMS	Ammonium	Sodium	Potassium	Magnesium	Calcium	Strontium	Barium	Lithium
Fluoride (Bifluoride)	R (Bi)	R	R		R	PR	R	TPR
Chloride	PR	PR	PR	TPR	PR	R	PR	TPR
Bromide	PR	PR	PR		P	P		P
Bromate		PR	PR					
Iodide	R	PR	PR		R			
Sulfide	TR	PR						
Sulfite (Bisulfite)	R (Bi)	PR	P					
Sulfate	PR	PR	PR	PR	R		R	TR
Bisulfate		R	TR					
Persulfate	PR		R					
Nitrate	TPR	PR	R	TPR	TPR	PR	TPR	TPR
Phosphate	PR	R	PR	P	R			
Carbonate	R	R	R	TPR	R	R	R	TPR
Bicarbonate	R	R	PR					
Thiocyanate	TPR	PR	TPR		P			
Acetate	PR	PR	PR	R	PR		PR	
Oxalate (Binoxalate)	PR		TPR (Bi)					
Borate	P	R	P					
Dichromate	PR		PR					
Molybdate	PR	TR						
Hydroxide	PR	PR	PR	P	PR	P	R	T
Miscellaneous		CYANIDE R SALICYLATE PR THIOSULFATE R STANNATE R TUNGSTATE R	FERROCYANIDE PR FERRICYANIDE PR CHROMATE PR	TRISILICATE P OXIDE PR SILICATE P				

KEY TO CHART
T—Technical Quality
P—Purified, U.S.P., or N.F. Quality
R—Reagent Quality
Black —Carloads
Gray —Tonnage

If you use process chemicals in tonnage quantities, you will want to know the chemicals and grades supplied by Baker.

The reference charts on these pages define the broad line of light and heavy metal compounds Baker supplies for production use. Other charts are described below.

These economical process chemicals provide you the security of Baker "measured purity" for your large-scale plant use.

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LIGHT METAL COMPOUNDS

J. T. Baker Chemical Co., *Executive Offices and Plant,*

Baker

Baker Industrial Chemicals

TONNAGE QUANTITIES
Metal Compounds

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Molybdenum									R	SODIUM & AMMONIUM MOLYBDATES:	TPR
Manganese	R		PR	R		R			PR		
Iron (Ferric)	R		R	PR						HYDROXIDE:	P
Iron (Ferrous)			PR							FERROUS AMMONIUM SULFATE:	PR
Cobalt	PR		PR	PR		R	R		R		
Nickel	PR		R	PR		R	R		R	NICKEL AMMONIUM SULFATE:	R
Copper	PR	R	R	TPR		R	R		R		
Zinc	PR	PR	PR	TR	P	R	TR	P	R		
Cadmium	PR		PR	R		R	R		R	IODIDE:	R
Mercury	PR		PR	PR			PR		TPR	IODIDE:	R
Aluminum	R		PR	TPR	P		R		R	HYDROXIDE:	PR
Tin (Stannic)	PR									SODIUM STANNATE:	R
Tin (Stannous)	TR								R		
Lead	TR		R	TPR		R	TPR	R	TPR	THIOCYANATE:	P
Bismuth	R			PR					R	OXYCHLORIDE:	R
Bismuth (Sub)				P						SUBGALLATE:	P

KEY TO CHART
T—Technical Quality
P—Purified, U.S.P., or N.F. Quality
R—Reagent Quality

Black – Carloads
Gray – Tonnage

HEAVY METAL COMPOUNDS

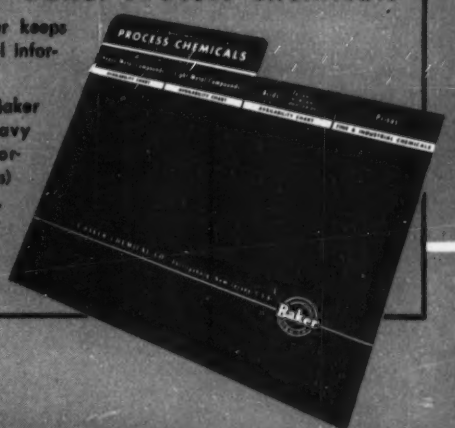
Phillipsburg, N. J.

FREE Reference File—Baker Process Chemicals

This handy letter-size file folder keeps all your Baker process chemical information handy.

Contains availability charts of Baker Light Metal Compounds, Heavy Metal Compounds, Acids (Inorganic, Organic, Acid Anhydrides) and complete price schedules.

A post card from your secretary brings you this free, useful reference guide promptly.



"Purity by the ton"

of greater amounts of chemical pulp for manufacture into newsprint. Most development work has been on chemical pulping methods for hardwoods.

Three processes—chemigroundwood, neutral sulfite semichemical and cold soda—are the most promising, according to the report. They yield pulps with strengths between softwood groundwood and sulfite. In blends with poplar groundwood, indications are that these allow displacement of some or all of the costly softwood chemical pulp, besides displacement of softwood groundwood.

CHEMIGROUNDWOOD—Well along commercially (Great Northern Paper is building a 350 ton per day mill in Maine), this process treats hardwood blocks in a sodium sulfite-sodium bicarbonate liquor under pressure. After digestion, conventional grinding yields 85-90% pulp that normally doesn't have to be bleached. Significant cost savings are indicated over softwood groundwood pulp.

SEMICHEMICAL—In the U. S. and Canada, 26 mills, with 3,000 tons of daily capacity, now use this process. First tried in 1925, it's similar to the chemigroundwood process except that chip wood is used and the softened chips are usually fiberized in a disk mill. Yields are 70-85% pulp, depending on the severity of treatment—strength generally increases as yield is lowered. Cost of finished pulp is at least 25% below semibleached kraft or spruce sulfite pulp.

COLD SODA—Still in development here, but due for commercial runs in Italy very shortly. Wood chips are steeped in relatively strong sodium hydroxide, then passed through a disk refiner for complete fiber separation. Pulp yield is about 90% and no bleaching is needed if a light-colored wood, such as poplar, is used. Direct substitution of cold soda pulp for softwood groundwood is not economical. Its advantage lies in combining it with poplar or other hardwood groundwood pulps.

New levulose process goes commercial

The only domestic producer of crystalline levulose, Pfanstiehl Chemical Corp., is just about ready to start up a new 1,500 pound a month plant at Evanston, Ill. They'll use a new process that selectively ferments any disaccharide. Glucose is fermented out and optically active levulose can be isolated in pure form.

Markets for levulose right now are fairly small. But there are some mighty lucrative potentials. For example, the honey industry says it could use 30-90 million pounds a year to prevent sugar crystallization. Intravenous dextrose is used to the tune of 3.5 million pounds annually and levulose —at the right price—could displace a big chunk of that.

Some of the levulose derivatives have interesting outlooks, too. Pfanstiehl plans to develop and promote such products as lactones, lactone salts for sequestering and sugar acids.

Chief by-product of the process will be gluconic acid. This can be converted to sodium gluconate, a sequestering agent used in dairies, or to calcium gluconate, which is used in calcium therapy.

But paradoxically, there's a good chance the new plant may become obsolete before it's out of its infancy—and the developers are happy. Pfanstiehl is hot on the trail of a brand new raw material, rich in levulose, that won't require their complex separation process. If it pans out, prices should tumble, giving levulose significant tonnage possibilities.

Industrial water distilled from the sea

First U. S. industrial application of ocean water distillation will be undertaken by Pacific Gas and Electric Co. at a $44 million power plant it's building at Morro Bay, Calif. Although not of a chemical nature, chemical firms are watching the development with great interest, particularly those in water-shy California.

Two triple-effect evaporator sets will be installed, each costing $200,000 and having a combined capacity of 100 gpm. To minimize salt crusting, PG&E will maintain high salinity (150% of normal sea water) and low boiling temperatures (190, 162 and 123 F. in the three effects). Also, water entering the first effect will be treated with corn starch and disodium phosphate.

Iranian oil will flow, but not here

Although there's been no official ratification by Iran's parliament, most parties to the long oil dispute there consider the affair settled—and happily. The end came quickly, considering the three years spent in haggling, and by 1957 crude oil production in Iran should be restored to its pre-nationalization level—600,000 bbl. per day.

But little if any of this new oil is expected to reach U. S. markets. And any that does will only displace other foreign crude. The outlook for the next few years is certainly not for increased importing of oil or oil products.

The final compromise between Iran and the eight-company consortium that sought to restore

(Continued on page 112)

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production had few surprises (see Chementator, June 1954, p. 110). With the exception of a compensation clause, it looks much like the agreements now in effect with other Middle East countries.

The consortium and National Iranian Oil Co. will form two separate companies to operate the oil fields and refinery. Full management authority goes to the consortium which will split the profits with Iran on a 50-50 basis. Production will run about 300,000 bpd. of crude oil the first year—higher than most oil men thought possible—rising to about 600,000 bpd. by the third year. Each member of the consortium will market its own share of production independently.

Iran's income will go up accordingly, to a high of about $190 million—including taxes paid—in the third year. The agreement is valid for 25 years, with three additional five-year options.

As for compensation, Iran will pay Anglo-Iranian Oil Co. (40% partner in the consortium) $70 million over ten years in final settlement of all claims and counter-claims.

Startup of the huge Abadan refinery is expected shortly after crude production begins. Refinery runs will eventually hit about 250,000 bpd., compared with 550,000 prior to nationalization. The emphasis will be on light fractions rather than the heavy oils that used to be the bulk of the output.

With the exception of the pro-communists, just about everyone is optimistic about the feasibility of the compromise. Because gradual return to normalcy is the key to the plan, there should be little disruption of present oil markets, particularly our own domestic ones.

And they're still jumping into titanium

Working in anything from tiny basement labs to million dollar pilot plants, a seemingly endless multitude is trying to unlock the door to successful production of cheaper titanium metal. Latest to reveal their interests are the Glidden Co., long a power in titanium pigments, and Horizons, Inc., both of Cleveland.

Glidden's sally into the fray will be via a pilot plant at Baltimore, Md., to be built in conjunction with a new 12,000 ton-a-year TiO_2 unit. There the company will test a new "electrolytic-electronic" process worked out in its laboratories. The cost of the combined project will be $12 million and if the pilot plant is successful Glidden will go ahead with a $30 million titanium metal plant—without government financial aid.

Also forsaking the Kroll process, Horizons has engaged Singmaster & Breyer of New York to design and build a $564,000 pilot plant at Stamford, Conn. The General Services Administration is lending the money and will be repaid through future metal sales to the government.

The process, like Glidden's, is electrolytic. Potassium titanium fluoride and salt serve as the electrolyte, graphite and iron as electrodes. Argon gas blankets the system.

Cyanoethylation on the move

With one big pilot plant just starting production and another under construction, a relatively untried process for treating cotton—cyanoethylation—is emerging from the laboratory. And with it move the hopes for establishing an important new market for acrylonitrile.

What the treatment accomplishes is this: cotton is made completely rot and mildew proof, much more heat stable and is more readily dyed. In addition, it exhibits greater stretch.

Much of the basic research on the process was done by the Institute of Textile Technology in Charlottesville, Va. Cotton is pretreated with aqueous caustic, then reacted with acrylonitrile. Properly done, this leaves 3-5% nitrogen firmly attached to the cellulose polymer. The product is then neutralized with acetic acid, water-washed and dried.

So far, though, cyanoethylation has been strictly on an experimental basis. For its commercial possibilities, the industry will have to watch the pilot plant operations of two big acrylonitrile producers—American Cyanamid and Monsanto.

Cyanamid, concentrating mostly on a continuous method for treating fibers, has completed a plant at Standard-Coosa-Thatcher Co.'s big cotton mill at Rossville, Ga. Evaluation lots will go to a majority of southern cotton mills. Processing costs are the big unknown and to complicate the technology picture, it's considered likely that continuous production will necessitate the use of pressure to speed up the reaction.

Monsanto, on the other hand, has chosen to put its emphasis on fabric treating. Working with ITT and Fulton Bag & Cotton Mills of Atlanta, the firm will turn out experimental product from a pilot plant now being built near Texas City.

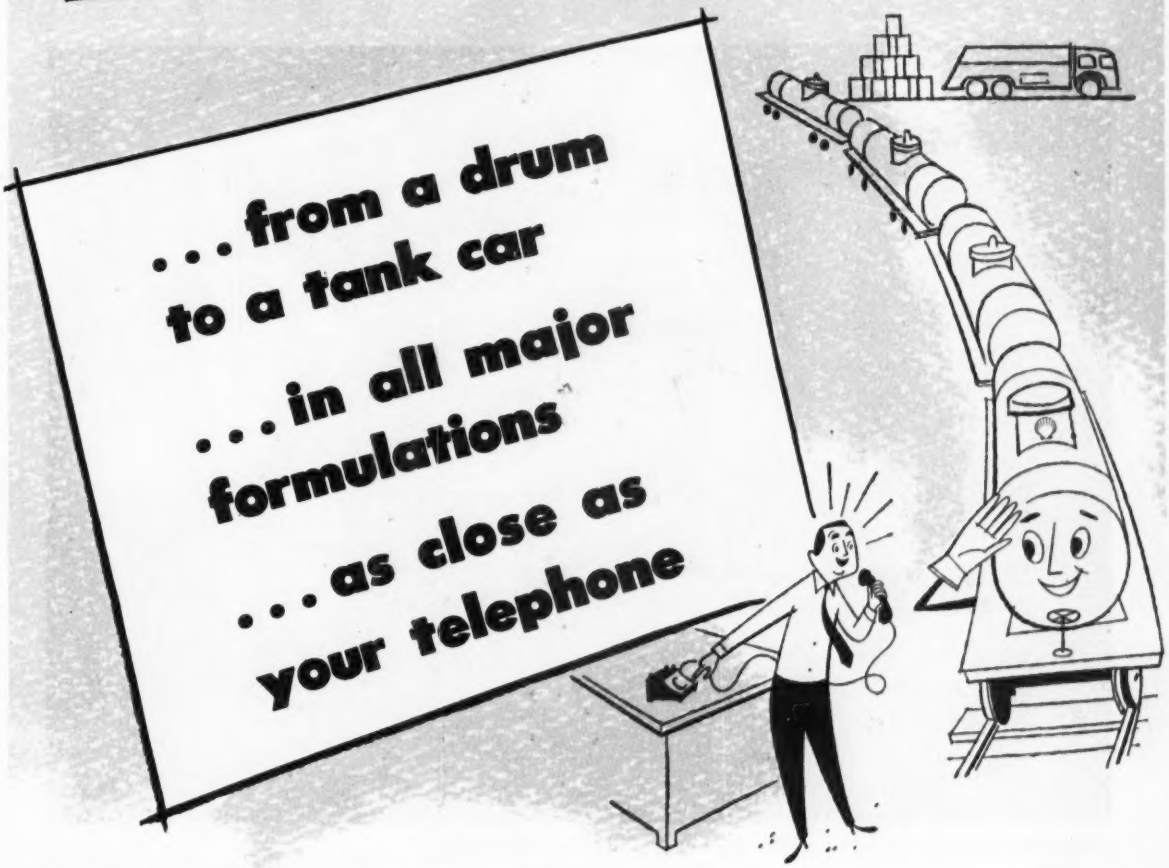
Neither Monsanto nor Cyanamid has any intention of getting into the cotton treating business. Their sole aim is to push this possible new outlet for acrylonitrile by doing the process work themselves.

For more of WHAT'S HAPPENING 114

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As THE NEED for dependable petroleum-derived ethyl alcohol has become more and more urgent, Shell Chemical has expanded its distribution facilities.

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*Tank truck and drum availability west of Rocky Mountains is limited.

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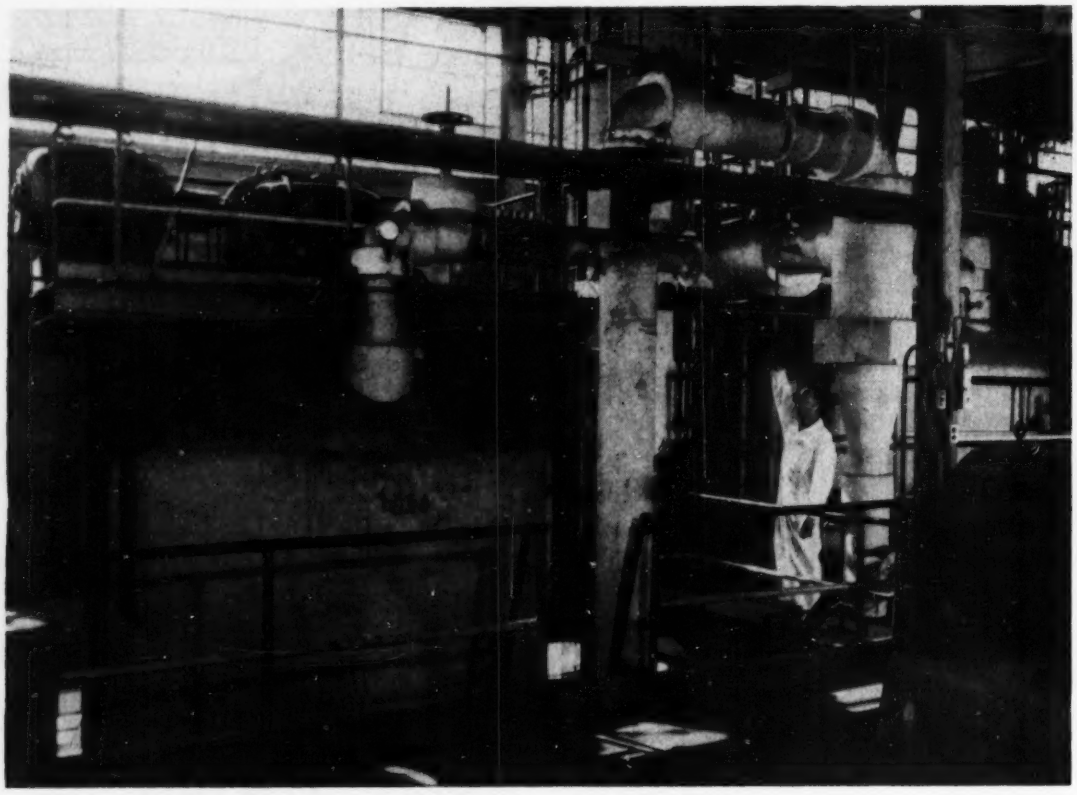
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OCTOBER
1954

What's Happening



OXIDATION of lignin, heart of process, takes place in these agitated reactors.

New Vanillin Process Meets Tariff Barrier

Here's how Ontario Paper Co. found the key to successful use of lime for alkaline oxidation of waste sulfite liquor to produce vanillin.

When a papermaker can go into the fine chemicals business and meet established competition across a tariff wall, he has something.

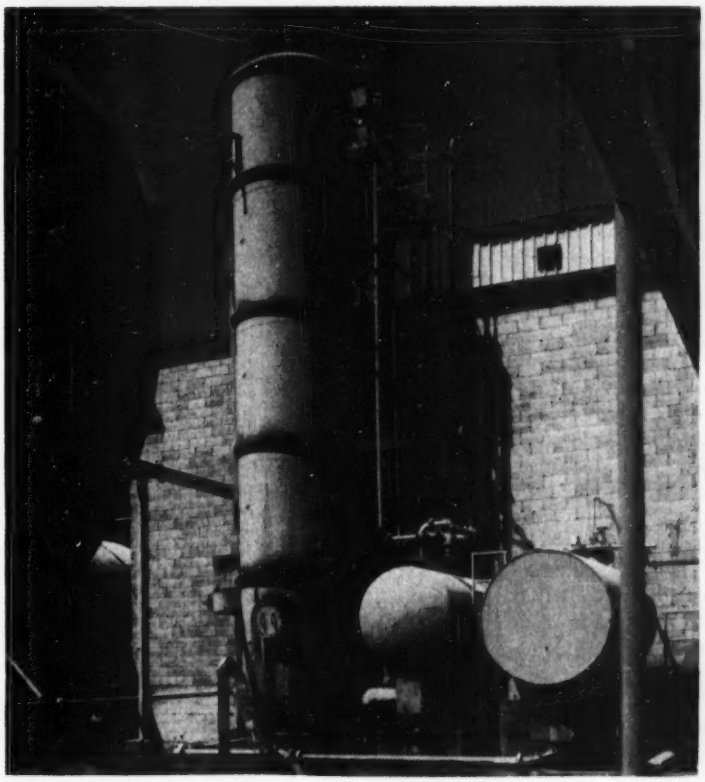
That description fits Ontario Paper Co., whose production of vanillin from waste sulfite liquor at Thorold, Ont., is sold at a competitive $3 per lb. in the United States by Dow Chemical Co. in spite of a U. S. tariff amounting to 71¢ per lb. (22½% plus 3½¢).

Ontario Paper's novel process is noteworthy not only economically but technically as well. It's based on oxidation of lignin-containing sulfite liquor in the presence of lime —a method which everyone "knew"

in Chemical Engineering

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EXTRACTION with toluene recovers vanillin from oxidized liquor.

would give only minute yields. But Ontario researchers found an optimum combination of operating variables which gives respectable yields of 6 to 8%.

▶ **Meeting the Tariff Barrier**—Ontario Paper Co. has long looked forward to the day when it could fully utilize its sulfite waste liquor. First commercial success along this line was production of ethyl alcohol by fermentation of the hexose content of the liquor. A plant built during World War II to furnish badly needed alcohol is still operating successfully at a production rate of 2,500 U.S. gal. per day.

Research on additional products and processes really got rolling after the war, under the direction of Dr. Charles Sankey. By 1948, Sankey and coworkers, including the Ontario Research Foundation of Toronto, had turned up enough novel ideas on vanillin manufacture to apply for international patent coverage. Three key U. S. patents were issued in late 1951 (2,576,752-4). Pilot-plant work, meanwhile, was in progress during 1950-51.

In spite of definite economies over other processes for making vanillin,* Ontario Paper's chances of breaking into the U. S. market were doubtful until the Torquay conference cut the tariff on vanillin in half (it had been 45% plus 7¢, for a total of $1.42 per lb.). Cheered by the conference action, company officials authorized construction of the present plant. Completed in December 1952, it cost $1.4 million and has a capacity in excess of 400,000 lb. per yr. of combined vanillin and Lioxin. Half of this output is currently going to U.S. consumers.

▶ **Chemical Intermediate**—Lioxin is the company's trade name for a product containing 97% vanillin, together with other components which give it specific characteristics. Its odor and taste are distinctively

* Other commercial processes for making vanillin: (1) from oil of cloves, through eugenol and isoeugenol; (2) from phenol, through guaiacol—the usual synthetic procedure; and (3) alkaline oxidation of lignin, using caustic soda.

different from vanillin, and it cannot be substituted normally for vanillin.

However, because of its high vanillin content and its $2.25-per-lb. price tag, the company is trying to develop Lioxin as a chemical intermediate for new uses where the more expensive vanillin would be uneconomic. With the entire U. S. consumption of flavoring vanillin only about one million lb. per yr. Ontario Paper looks to Lioxin as the product with a bigger future.

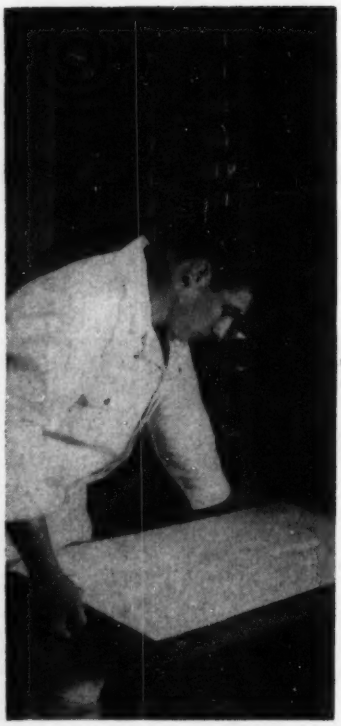
▶ **Process Development**—Although alkaline oxidation of lignin to vanillin is an old process (known since 1905), its commercial embodiment (as practiced by Salvo Chemical Corp., Rothschild, Wis.) has previously required the use of sodium hydroxide as the hydrolyzing agent. Vanillin yields are good—12-14%. Chief drawback is that NaOH must be recovered for maximum economy.

Ontario's Dr. Sankey figured that use of lime instead of caustic soda might be more economical in spite of lower yields on a lignin basis. Lime was much cheaper (fines were available from nearby North American Cyanamid) and recovery would be unnecessary.

Another unique advantage would be operation of a vanillin unit in conjunction with the Thorold alcohol plant. Consumption of the hexose content of the liquor in making alcohol reduces the lime requirement by approximately one-third. And carbon dioxide given off during fermentation could be used to help acidify the liquor after hydrolysis.

So researchers set their sights at boosting the trace yields reported in the literature to some reasonable level. This involved a complete exploration of process variables—time, temperature, lignin concentration, partial pressure of oxygen, pH and agitation.

▶ **Unexpected Results**—Contrary to usual concepts of thermodynamics, Sankey's group found that yield was higher at lower concentrations of lignin. And contrary to theoretical principles of chemical engineering reactor design, yield from a single reactor was higher when operated continuously than when operated batchwise.



PURE vanillin comes out of tray dryer.

Dr. Sankey explains these apparent anomalies partly in terms of the solids present in the process. The solid phase, consisting of lime, calcium carbonate, calcium sulfate, calcium oxalate and calcium-lignin compounds, adsorbs some of the vanillin. In dilute liquor, the quantity of material in the solid phase is less (more is in solution), therefore the amount of vanillin adsorbed is less.

Yield of vanillin is extremely sensitive to pH. Alkalinity must be kept above pH 12 at all times throughout the reactor. This requires good agitation to keep the lime well dispersed.

Oxygen partial pressure must be controlled to avoid overoxidation with resulting yield loss. Optimum pressure is a function of temperature. For operation at 170 C., partial pressure should be less than 20 psi. At higher temperatures, oxygen partial pressure should be lower. Total pressure, of course, includes partial pressure of nitrogen and steam in addition to that of oxygen.

▶ **Plant Operations**—Starting material for vanillin production is the effluent from the alcohol plant. This liquor is more dilute than the original sulfite liquor, which is all to the good, as pointed out above.

Lignin solution, lime slurry and compressed air are fed continuously into two parallel vessels 10 ft. dia. by 20 ft. high, equipped with turbine agitators.

Reactors effluent goes through continuous solid-bowl centrifugals for removal of sludge, thence to two tanks in series for acidification. Carbon dioxide from the alcohol plant is bubbled through the liquor in the first tank; sulfuric acid completes the job in the second. A pressure-leaf filter clarifies the acidified liquor.

The vanillin content of the liquor is recovered by continuous countercurrent extraction with toluene in a tower 7½ ft. dia. by 58 ft. high. The toluene extract, in turn, is washed batchwise with caustic soda in a small mixer-settler vessel, reaching a concentration of 10 to 12% in the caustic soda.

The caustic solution of vanillin and coproducts goes through a series of separation steps leading up to distillation of an oil at an absolute pressure of 2 mm. Hg. The distilled product is Lioxin, which may be run from the still receiver into cooling pans and then broken up in a jaw crusher.

Or the distillate may be purified by dissolving it in water, treating with activated carbon, filtering out the carbon, crystallizing under vacuum, centrifuging the crystals, and vacuum tray drying. Product is pure vanillin.

▶ **Hopes for the Future**—Ontario Paper Co. is eyeing the chemical market as its biggest potential outlet for products made from lignin. In addition to Lioxin, other product possibilities are vanillic acid—now going to the sewer with the raffinate from the toluene extraction—and both vanillil and acetovanillone, which can be recovered as separate products.

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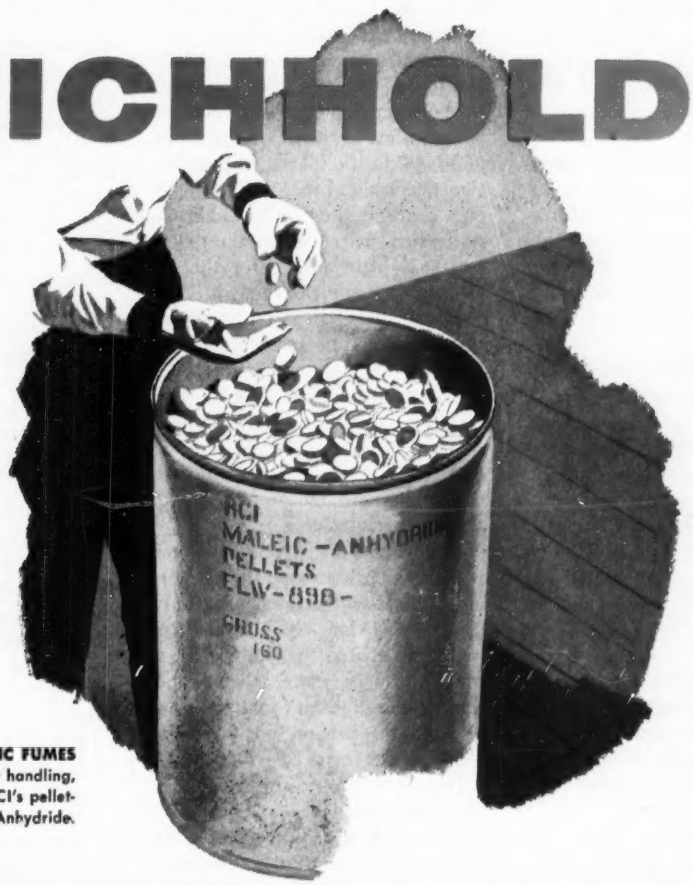
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Chemical Process Industries Are Using Radioisotopes...

for Tracing...	for Measuring...	and for...
Reaction paths	Chemical composition	Catalyzing reactions
Catalytic action	Thickness and density	Cold sterilization
Flow of fluids	Viscosity	Radiography
Position of materials	Extent of corrosion	Eliminating static hazards
Distribution patterns	Wearing rates	Luminescence

Uses for Radioisotopes Are Mushrooming

New applications for radioisotopes and radioactivity turn up almost daily. Here's a round-up of some of the newest and most important.

Today's applications of radioisotopes range all the way from catalyzing "impossible" reactions to analyzing the products, from cold sterilization to the measurement of physical properties.

In the eight years that these materials have been available to industry, Atomic Energy Commission sales have leaped from nothing in 1946 to about $1.2 million during 1953. And nearly every segment of industry has put these materials to work.

▶**New Method, New Products**—Of the many ways in which the chemical industry can profitably employ radioisotopes, possibly of greatest potential importance is the application to catalyzing reactions. Chlorination of hydrocarbons and the polymerization of monomers, notably ethylene, are now carried out on a bench scale using radiation from isotope sources as catalyst for the reaction.

With this technique entirely new polymers—never before made by any method—are obtained. These include polyperfluoropropylene, polyperfluorobutadiene and polyperfluoroacrylonitrile.

Researchers report that the method has several distinct advantages over methods using heat, pressure or the usual catalysts. Reactions take place at lower temperatures and pressures. For example, in polymerizing ethylene present processes use pressures on the order of 10,000 to 15,000 psi., with radiation this is sliced to 2,000 to 5,000 psi. Further, there is no addition of foreign matter to the reaction mix—and little chance for the reactants to poison the catalyst.

Deeper penetration of the radiation from isotope sources and the fact that it will penetrate steel gives this form of radiation an edge over ultraviolet light in catalyzing certain reactions. Ultraviolet light is limited by the necessity for quartz equipment and by its poor penetrating characteristics.

▶**Also Altered**—Isotope radiation will also alter the properties of present materials. Increased cross-linkage of the long-chain molecules make irradiated polyethylene a much stronger, more solvent- and temperature- resistant material.

With the proper type of radiation, rubber can be vulcanized—without resorting to sulfur or other chemical agents.

▶**New and the Old**—Sterilizing foods and drugs at room temperature with gamma radiation is now being studied. While the technique has proved feasible, problems of high costs and unwanted byproducts must yet be solved satisfactorily.

At present, massive doses of radiation are required to completely sterilize. But, in the food field particularly, "pasteurization" techniques, which use only mild doses, have promise.

One of the oldest industrial uses of radiation, radiography, has also been brought up-to-date. Radiography, in which X-ray pictures are taken of equipment parts, is more efficient when radioisotopes are used as the radiation source. The radiation has a greater penetration, hence larger pieces can be studied. And the source is more compact, therefore the equipment has greater mobility.

▶**Playing Tag**—By tagging one of the reactants in a chemical reaction it is possible to study the reaction mechanism. Among reactions currently under study are the Fischer-Tropsch reaction, hydrocarbon isomerization, alkylations and polymerizations. It is also believed that this tool will help us learn more about the mechanics of catalysis.

This technique has been called* "more important than the microscope for solving the fundamental

*S. E. Eaton of Arthur D. Little, Inc., before the Atomic Industrial Forum, March 16, 1954, New York City.



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How Radioisotopes Are Saving Money

$100,000,000

Some 860 industrial users of radioisotopes are now saving $100 million annually. By 1964 these yearly savings are expected to reach $1 billion.

$24,950

For $50 a company can buy an amount of cobalt 60 equivalent to an amount of radium worth $25,000.

$6,000

Using radioisotopes for inspecting Horton spheres saves $6,000 per 50-ft. sphere.

$50

With antimony 124 marking the liquid interfaces in oil pipelines, a $50 saving is chalked up every time a diversion valve is thrown.

$100,000

Investing $40,000 in thickness gages saved the Carborundum Co. an estimated $100,000 in the first year of operation.

$100,000

By narrowing the tolerance limit, radioisotope thickness gages give rubber companies better control of the quantity of rubber in tires and, in one case, saved $100,000 for one machine.

research problems of tomorrow." With radioactivity, detection of quantities below the ordinary limits of analysis is possible. This has already resulted in process improvements and in lower quality control costs.

▶**Physically, Too** – Aside from chemical uses, radioisotopes are introduced into physical systems. Followed by radiation counters, they can locate leaks and jams in pipelines; study catalyst flow in a reforming units and control the valves which divert product flow and prevent contamination of one product with another when two or more products flow through the same line.

Determing flow, diffusion and absorption patterns is another job tackled by these materials.

▶**Taking the Measure** – Radiation is absorbed by materials at a rate contingent upon the characteristics of the material, its density and the amount in the path of the radiation.

This fits radioisotope radiation for use in instruments measuring such properties as thickness, density and composition. Beta-ray thickness gages are widely used in the paper and plastics industries. Density gages, which determine the gamma-ray absorption of fixed volume of the material, claim an operating accuracy of 0.5%. Beta rays from the decay of strontium 90 are employed to measure the percent of hydrogen and the ratio of hydrogen to carbon in liquid hydrocarbon.

Over 300 companies of all types now use radioisotope thickness gages, with yearly savings averaging about 2% of the product value. They have proved most valuable during production start-up, when savings have reached 10 to 20% of the product value.

▶**Wear and Tear**–Rate of wear of metallic equipment parts has been measured by irradiating the part and either checking the drop in radiation intensity of the part while it is in use, or checking the rise of the radiation from the eroding material at timed intervals.

Corrosion in hard-to-get-to places can be detected and its extent measured by radiographing the spot with a radioisotope–say, cobalt 60 or iridium 192. The radiation leaves a picture of the corroded surface on the film. Its area and penetration can be easily measured.

This technique has been used to find hydrogen blisters on the inner surface of large refinery units.

▶**Eliminating Static** – A field in which the radioisotope has already proved its effectiveness is static elimination. Numerous installations in paper, textile, rubber and plastic plants have raised quality and economy and reduced fire and explosion hazards.

Although naturally occurring radiation sources (e. g., radium and polonium) still hold sway in this field, the trend is toward beta-emitting artificial isotopes, such as strontium 90, thallium 204 and promethium 147. The reason: greater effective range of radiation.

▶**The Bitter and the Sweet**–Not all is on the credit side with radioisotopes, however. Equipment cost and handling difficulties are often considerable. Then again, there are the "built-in" limitations. It is not always possible to get an isotope of a particular element with the proper half-life, activity or of the proper purity for a specific application. In fact, for elements such as oxygen and nitrogen no useable radioisotope is available.

At other times, it is necessary to employ so large an amount of an isotope that its use is not safe.

Bright spot of the picture is that radioisotopes are becoming more and more convenient to use. Instruments are more accurate and simpler to work, techniques have improved and more people are available who understand and can use the new methods. Finally, the materials are easier to get than heretofore, and waste disposal has been simplified considerably in recent years.

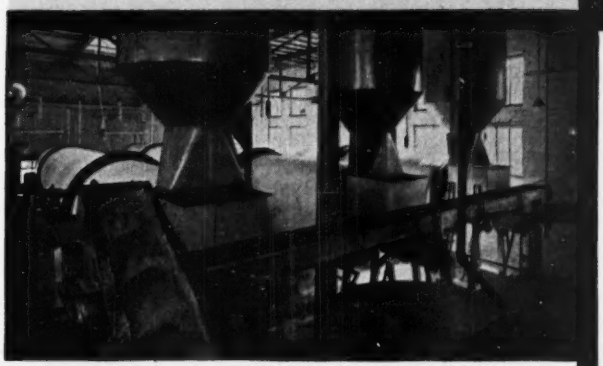
Hercules Studies New Use for Ammonia Plant

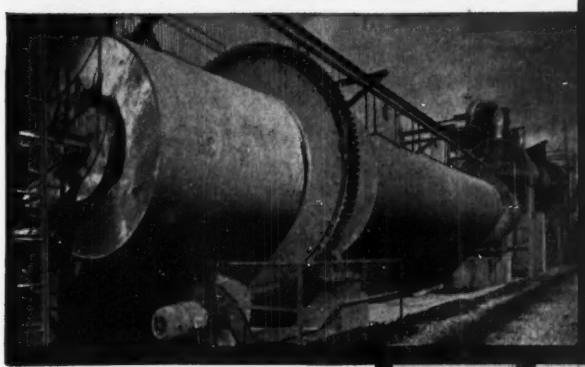
With production of anhydrous ammonia just started, Hercules Powder Co. is already considering making other chemicals at the Louisiana, Mo., plant it recently leased from the government. Foremost in the company's thinking right now are methanol, formaldehyde and pentaerythritol.

One of the plant's three ammonia lines could readily be converted to produce methanol. Then, using the same process employed at Hercules' Mansfield, Mass., plant, methanol would be oxidized to formaldehyde, major raw material for pentaerythritol.

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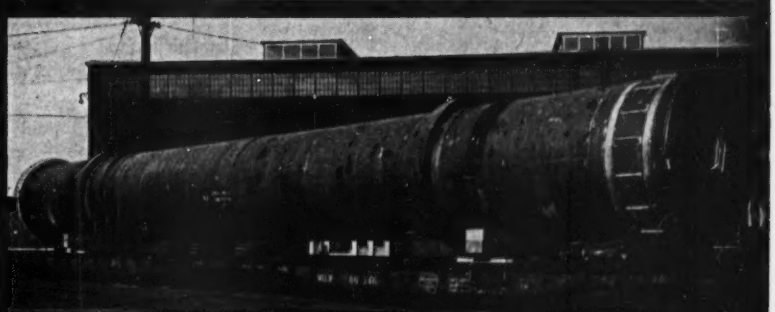
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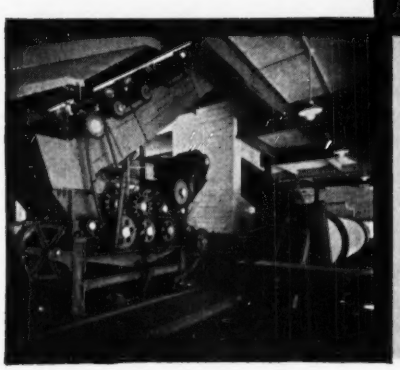
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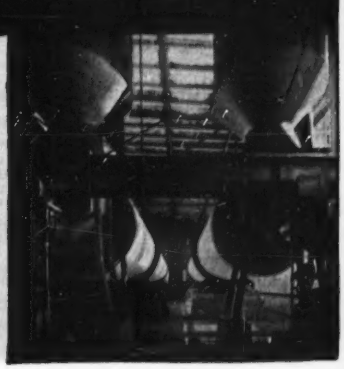


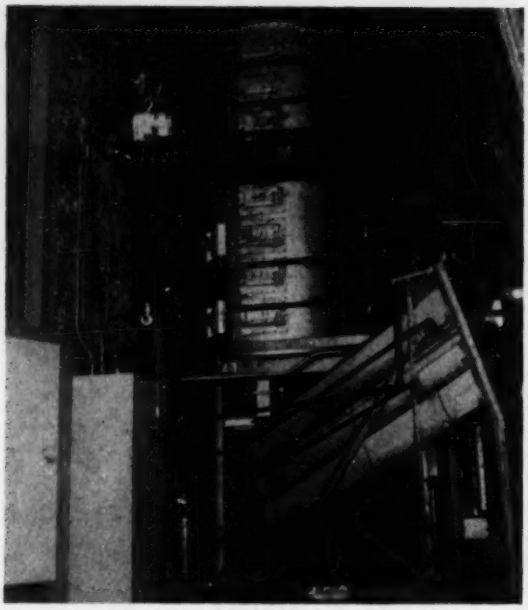


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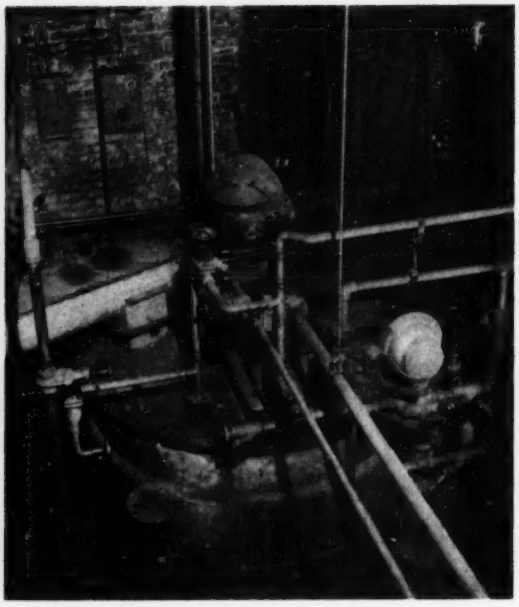
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MULTIPLE-HEARTH KILN reduces the manganese.



LEACH TANK uses nitric acid to dissolve the manganese.

New MnO_2 Process Looms as Cost-Cutter

Hopes of drastically lowered costs have brought government backing to this new process for high-grade manganese dioxide. Here's how it may save money.

Simplicity is the word for a new process for high-grade manganese dioxide being developed by E. S. Nossen Laboratories, Inc., Paterson, N. J., and now in the 1,000-lb.-per-hr. pilot plant stage. Bypassing both conventional ore dressing methods and high cost electrolytic processes, the Nossen process takes a chemical tack to produce both metallurgical grade and battery-active MnO_2 from domestic low-grade ores.

Although low-grade manganese ores are abundant in the United States, high refining costs have thus far held production to only about 10% of the nation's needs. As a result the U. S. has had to rely on imports—particularly from the high grade deposits of Africa's Gold Coast—to make up the difference. Uncertainty of this supply, especially in war-time, has put many a gray hair on the brows of both government and industry men—for manganese is essential to steel production (13 lb. per ton of steel) and the battery-active variety is a widely used depolarizer for dry-cell batteries.

Initial interest in the new process came from the government, whose General Services Administration has financially backed the pilot plant venture. Interest has also been sparked in industry, and Nossen Labs, a research and development firm, is standing ready to fan any flame.

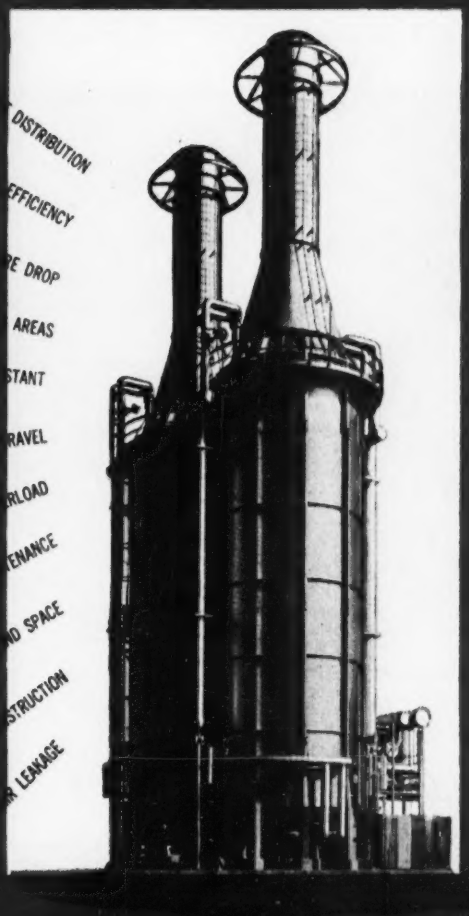
▶ **Can Slash Costs**—Low-purity manganese deposits (5 to 20% manganese) have so far defied commercial refining efforts based on classical ore dressing techniques. Although electrolytic methods have met with greater success (see *Chem. Eng.*, Jan. 1954, pp. 152-5 and pp. 372-5.), high investment costs are a drawback.

E. S. Nossen, vice president and director of research of Nossen Laboratories, claims that his process, which doesn't need electrolytic cells, expensive electrical conversion equipment or costly anode handling equipment, requires an investment of only about one-sixth that of an electrolytic process for a plant of the same capacity. And, since most of the process reagents are recovered, operating costs are also lower, says Dr. Nossen, a Holland-born ore expert who's worked with manganese ores for over 20 years.

▶ **Preparing the Ore**—Nossen's Paterson pilot plant takes a reddish-brown ore from Aroostook County, Me., containing about 11% manganese and screens it. Large chunks are jaw crushed and then all of the ore goes to a rod mill where it is ground to −60 mesh.

With the ore from Maine, leaching may be carried out di-

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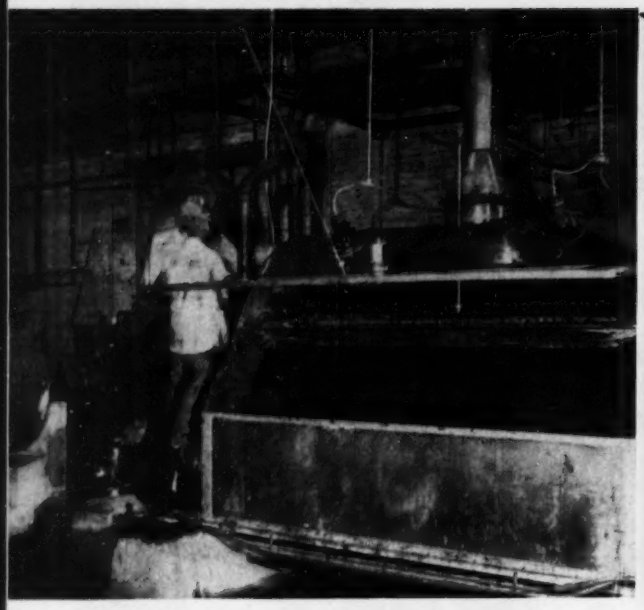


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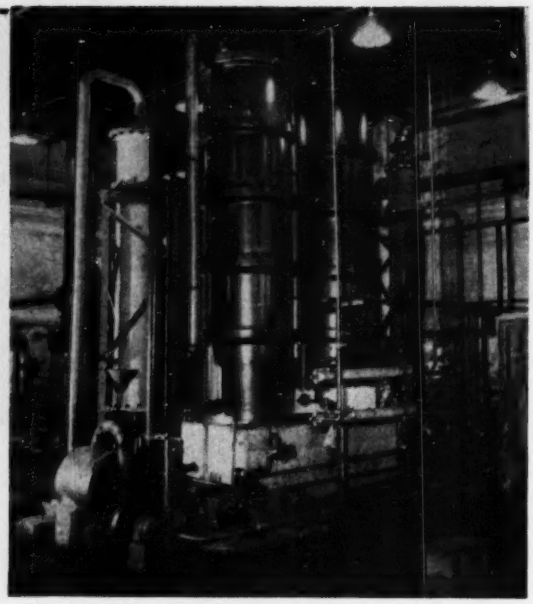
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DOUBLE-DRUM DRYER decomposes the nitrate to MnO_2.



SCRUBBING TOWERS recover nitric acid for recycle.

rectly, since reduction of the manganese to the manganous form is not necessary. Nossen, however, has provided a multiple-hearth reducing kiln to adapt the plant to other types of ore. When the kiln is used, a set of three covered and water-jacketed screw conveyors cool the reduced ore before it passes to the leach tank.

▶ **Leaching With HNO_3**—Nitric acid, diluted by the wash solution from a previous run, leaches the manganous oxide from the complex iron oxides, silica and alumina in the ore. With high calcium ores, calcium nitrate for fertilizer use is produced as a byproduct.

Temperature of the leach is held between 175 and 190 F., and the equipment is constructed of stainless steel to resist corrosion.

The leach tank discharges to a disk-type, continuous vacuum filter which separates the manganese nitrate solution from the gangue. Gangue is water-washed and the wash solution used to dilute the leaching acid. Filtered nitrate solution is evaporated at about 240 F. in a vertical, forced circulation evaporator to about 65% solids by weight. This slurry goes to the decomposition unit.

▶ **Decomposing the Nitrate**—The decomposition unit is essentially a steam-heated, stainless steel, double-drum dryer. When the slurry contacts the heated drums in the presence of air, the manganese nitrate breaks down into MnO_2, HNO_3 and some NO_2.

The HNO_3, together with the steam formed when the solution was heated, is condensed and recycled. NO_2 passes on to several stoneware scrubbing towers where it is recovered as nitric acid. This is also recycled to the leaching operation.

Manganese dioxide travels by screw conveyor to a ball mill (at far left of left-hand picture above) for grinding. It is then water-washed to remove soluble impurities—nitrates of calcium, sodium and manganese.

The product is flash dried with hot gases and bagged for shipment.

If a battery active grade is the desired product, temperature of the decomposition unit is critical—for the battery-active gamma variety of MnO_2 may be transformed into the inactive alpha variety at 660 F.

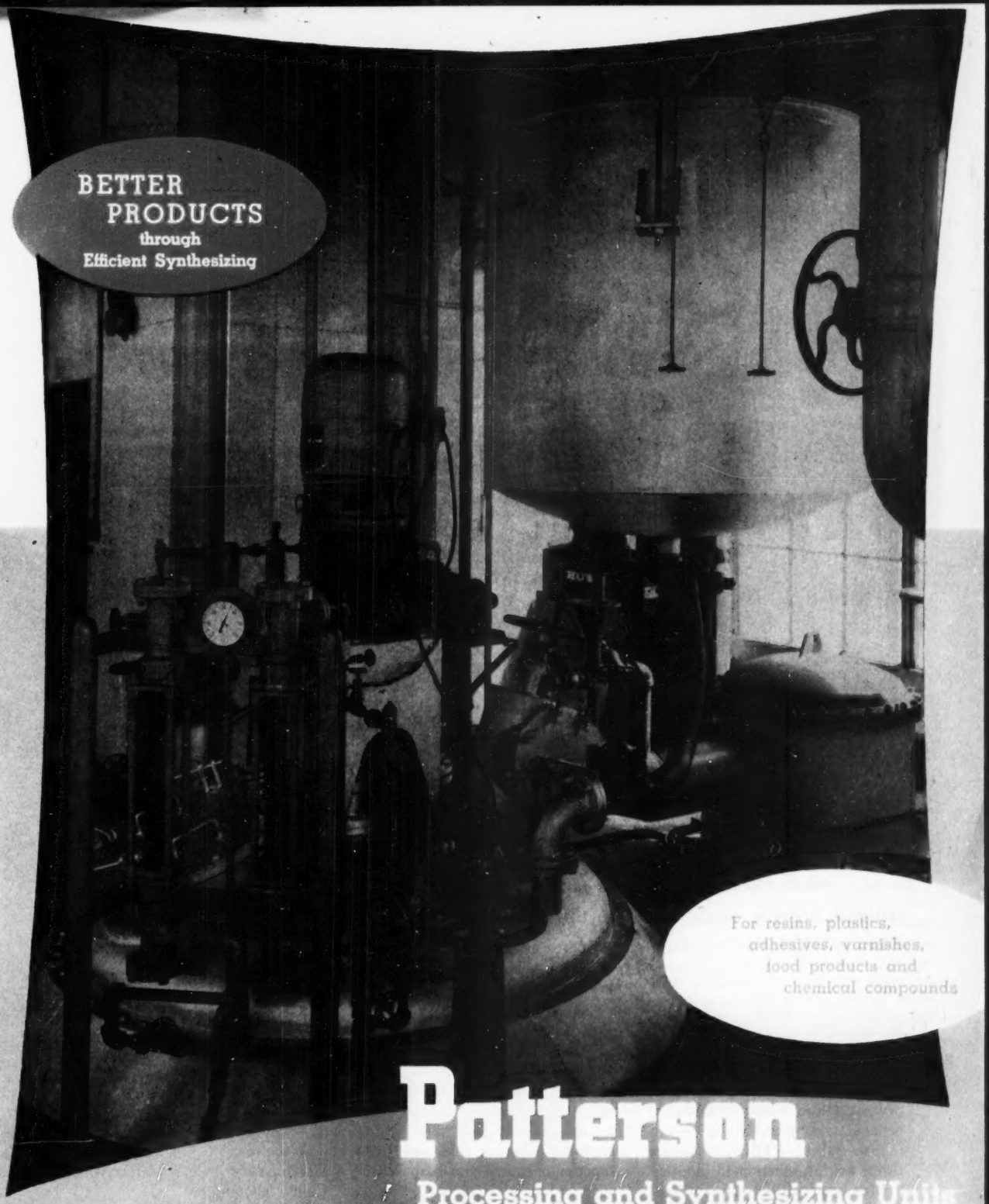
When the metallurgical grade is desired, the washed product is nodulized for easier handling.

Road to Better Anodes: Addition of Phosphorus

Contradicting much traditional theory, scientists at the American Brass Co. have discovered that incorporating 0.2-0.3% phosphorus in pure electroyltic copper gives anodes that cause 10-15% more copper to deposit on the cathode per lb. of anode. Until now, one of the axioms of electroplating has been that the higher the anode purity, the better the plating qualities.

According to American Brass, phosphorized copper anodes give freedom from anode sludge (no diaphragms needed), no copper build-up in solution and exceptionally smooth, heavy cathode deposits. These claims have been substantiated in commercial runs.

When placed into electrolyte, these new anodes develop a dark surface film that completely surpresses formation of metallic particles which ordinarily form sludge in the tank and build up copper in the plating solution. Thus scrap losses are very low. The film does not increase resistance to the circuit and no additional voltage is required.



Patterson

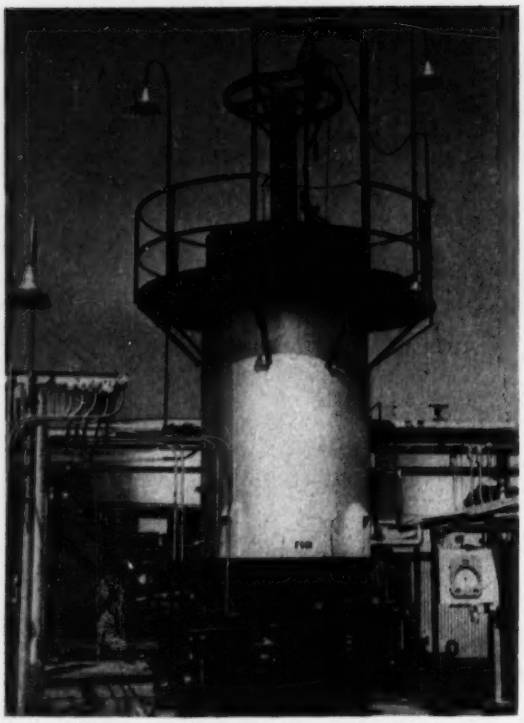
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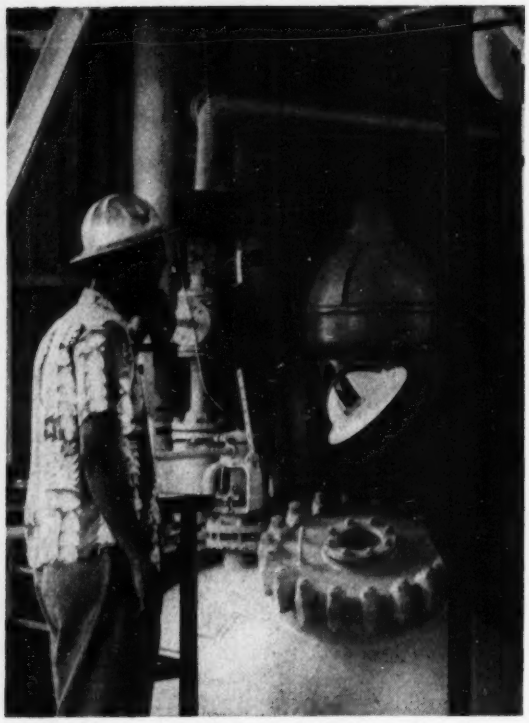
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CRACKING unit makes isobutylene, which is alkylated with toluene to tertiary-butyl toluene. This goes to the . . .



OXIDATION unit, a stainless steel autoclave. Here the substituted toluene reacts with air, opening the . . .

Way to New Monobasic Acids

Shell Chemical hopes to capture for its new substituted benzoic acids some of the huge markets now dominated by the aromatic dibasics.

First of a family of aromatic monobasic acids has recently made its commercial debut, and Shell Chemical Corp. is anticipating many suitors for the hand of its new product, para-tertiary-butyl benzoic acid. Shell is also preparing several of PTBBA's younger sisters for introduction to industry.

Members of this new product family are made by oxidation of various tertiary substituted toluenes. Oxidation of para-tertiary-butyl toluene, for example, gives para-tertiary-butyl benzoic acid.

Related products, not yet commercialized, could include benzoic and toluic acids.

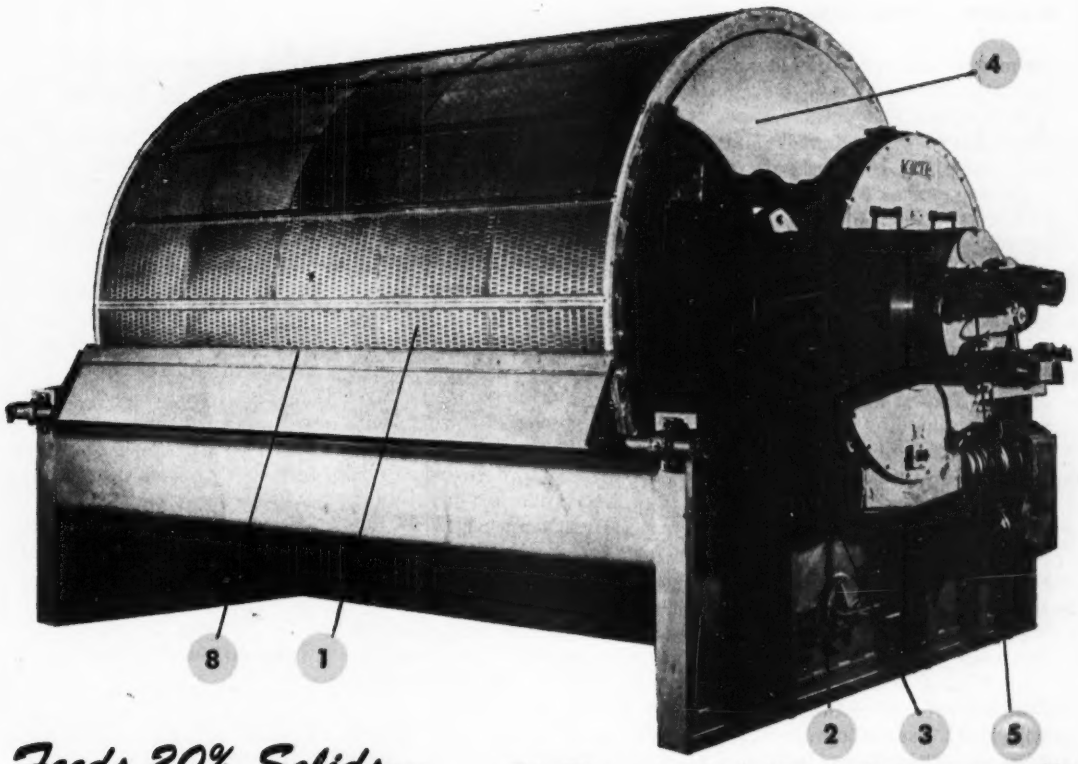
▶ **Commercial Prospects**—PTBBA's most promising suitor so far is the paint and varnish industry. Use of PTBBA as a partial replacement for the fatty acid content of alkyd resins, says Shell, gives faster air drying, shorter baking time, greater hardness, improved color and gloss, superior chemical and soap resistance and simpler cooking.

In alkyds containing 35-40% phthalic anhydride, Shell suggests using 7-13% PTBBA by weight of the original charge to get optimum resin properties. This amounts to 30-50% replacement of the fatty acid content on a chemical equivalent basis.

Another prospective outlet for PTBBA is in the preparation of plasticizers for vinyl and cellulose plastics. This involves esterification of the acid with alcohols or glycols, such as diethylene glycol or dipropylene glycol. Metal salts of PTBBA—e.g., strontium, barium and cadmium—show promise as heat and light stabilizers for vinyl resins. Other potential uses for various metallic salts are paint driers, preservatives for oils and fats, corrosion inhibitors, greases, specialty soaps, fungicides and insecticides.

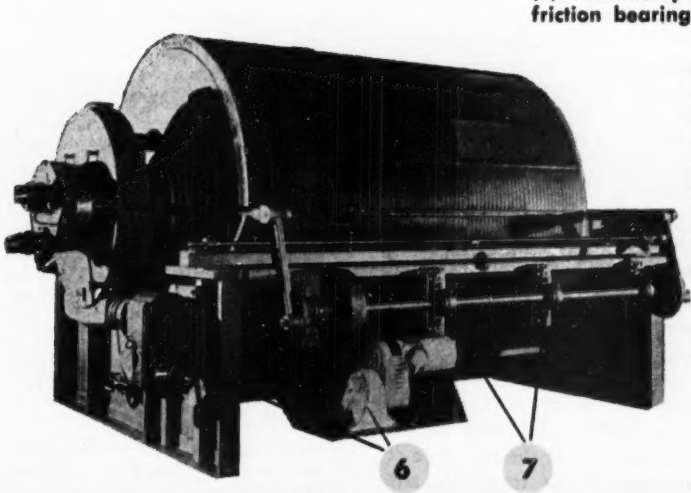
▶ **Up from Research**—PTBBA and its yet-to-be-announced sisters came out of a research program at Shell Development Co.'s Emeryville, Calif., laboratories.

Investigators there were aware of the great disparity in consumption of aromatic monobasic acids vs. aromatic dibasics. Whereas the two leading dibasics, phthalic anhydride and terephthalic acid, account for some 300 million lb. per year, sales of benzoic acid, the only



Feeds 20% Solids--
Cake 89% Solids

This filter, a standard drum continuous vacuum filter design with most advanced features adapted for the customer's problem, incorporates such items as (1) rubber grids of thermo plastic type, (2) easy access through quick opening tank covers, (3) counterweighted pin type agitators, (4) steel drum-heads mastic coated, snap blow, rubber base plastic piping, (5) marine bronze valve and wear plate, (6) variable speed drives on drum and agitator, (7) anti-friction bearings on agitator shaft.



In operation a dutch weave wire cloth is caulked in the grooves and the snap blow lifts the cake from the panel away from the drum surface so that the (8) rubber tipped blade never touches the drum.

All Eimco filters are engineered and designed with the idea of prolonging cover or bag life. Eimco engineers will consult with you in the selection of the correct media for best filtration and longest life and supply you with samples of Eimco media for your own laboratory work or will advise you on shipment of samples to Eimco Research Center for free filtration analysis.

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commercial aromatic monobasic, amount to less than 1 million lb.

Shell figured that possibly some substituted benzoic acids might find wider usage than benzoic itself.

Laboratory work established that PTBBA and some other tertiary-substituted benzoic acids could be obtained in good yield simply by blowing air through the hot, liquid hydrocarbon in the presence of a cobalt catalyst. After further process development work in the laboratory, Shell Development took the operation into a pilot plant, with a capacity of about 1,000 lb. per day.

Shell Chemical has now taken over commercial production at its Martinez, Calif., plant, using certain facilities there which serve as an all-purpose special products unit. This unit can turn out "several thousand" lb. per day of PTBBA.

If PTBBA and family develop into big tonnage chemicals, Shell will likely transfer operations to Houston, getting nearer to Eastern and Midwestern markets.

▶**How It's Made**—Shell makes its own tertiary-butyl toluene by alkylation of petroleum toluene with isobutylene; the latter comes from Shell Oil's adjacent refinery.

Oxidation of TBT to PTBBA takes place in a Type 316 stainless steel autoclave operating at 150-175 C. and 50-75 psi. gage. Compressed air enters via a sparger just below the agitator. Depending on specific operating conditions and desired degree of conversion, production of one batch takes about 2-4 hr.

Optimum degree of conversion depends on several factors. At high conversions, reaction rate falls off. In addition, there is an increase in nonacidic byproducts. There is another practical limitation—at conversions about 60% the high concentration of PTBBA in the reactor effluent causes mechanical difficulties in the product recovery section. Shell has found 50% conversion to be about right.

Heat of reaction is about 185,000 Btu. per lb.-mole of oxygen consumed. Part of the heat goes into warming up the cold feed, part of it evaporates some of the TBT (which is condensed and refluxed) and the rest is taken out via water-cooled coils and jacket.

Water formed in the reaction is removed immediately by separating it from the TBT reflux before the latter returns to the reactor. If allowed to accumulate in the reactor and form a separate phase the water would extract the cobalt catalyst and stop the reaction.

About 1% of the feed oxidizes to terephthalic acid, which is insoluble in the hot liquid product. Some of the terephthalic builds up on the cooling surfaces of the reactor; these surfaces must be cleaned occasionally by washing with hot soda ash solution. The terephthalic acid discharged along with the reactor product is removed in a leaf filter. The filter is as close to the reactor as practical; the filter and the connecting line are kept hot to prevent precipitation of PTBBA.

▶**Product Recovery**—Treatment of reactor effluent with solid NaOH precipitates the sodium salt of PTBBA: the salt is removed in a basket centrifugal, using TBT (reactor feed) and then water to wash the crystals. PTBBA is sprung from the sodium salt by reaction with acid. Crystalline product is finally dried in a vacuum tray dryer.

Recovery step in the pilot plant at Emeryville involved direct crystallization of PTBBA instead of precipitating the sodium salt. Disadvantage of this procedure was that appreciable solubility of PTBBA in warm mother liquor required cooling to 20-30 C. in order to get good recovery. Since product crystals fouled up cooling surfaces badly, Shell had to inject water into the vessel and evaporate it under vacuum to get the cooling.

▶**Safety Precautions**—At oxygen conversions below 60% there is the possibility of having an explosive mixture in the gas phase of the reactor. The reactor is protected with a bursting disk to prevent vessel failure in case of an explosion. In addition, reactor off-gas goes through an oxygen analyzer which can be set to shut off the air flow in case the oxygen concentration exceeds any desired value.

First Isopentane Unit Going Up in Britain

Isopentane, an important component of aviation gasoline, will get its United Kingdom production debut at Shell Petroleum Co.'s refinery at Cheshire, England. The new plant, which will go on stream early next year, will cost $1.4 million. It will operate in conjunction with a recently built Platformer.

Debutanized light platformate will be depentanized in a conventional bubble-cap tower. Overhead will then go to a de-isopentanizer —200 ft. high with 140 Turbogrid trays—together with debutanized straight-run gasoline. Isopentane will be taken overhead.

Convention Calendar

Industrial Packaging and Materials Handling Engineers, ninth annual exposition, Chicago Coliseum, Chicago, Ill., Sept. 28-30.

Symposium on the applications of radioactivity in the rubber and plastics industries, sponsored by Tracerlab, Inc., Sheraton-Plaza Hotel, Boston, Mass., Oct. 6-8.

Commercial Chemical Development Association, growth and influence of foreign chemical developments, Bedford Springs Hotel, Bedford, Pa., Oct. 7-8.

American Oil Chemists' Society, symposia on analysis, surfactants, waste disposal and drying oils, Hotel Radisson, Minneapolis, Minn., Oct. 11-13.

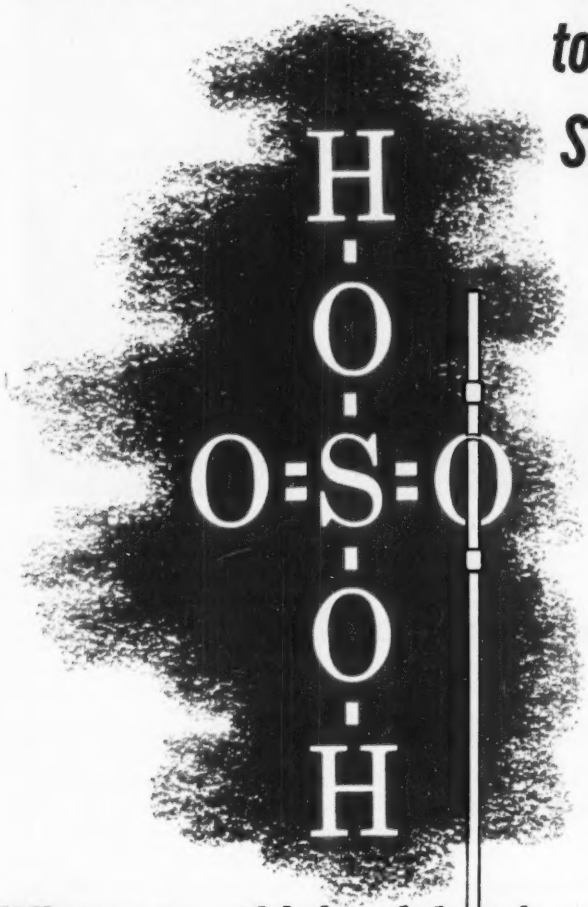
American Institute of Chemical Engineers, New York Section, symposia on 1) new developments in the petroleum and chemical industries and 2) cost estimation, Hotel Statler, New York, N. Y., Oct. 13.

Eighth National Chemical Exposition, Chicago Coliseum, Chicago, Ill., Oct. 12-15.

National Safety Council, 42nd congress and exposition, Conrad Hilton Hotel, Chicago, Ill., Oct. 18-22.

Plastics in Building, sponsored by The Society of the Plastics Industry, Manufacturing Chemists' Association and the Building Research Advisory Board, National Academy of Sciences, Washington, D. C., Oct. 27-28.

When *is Lead used to control Sulphuric Acid Corrosion?*



Sulphuric acid is like "Peck's Bad Boy."

It has plenty of outstanding qualities, but it's hard to control.

Ordinarily, lead is the metal used by industry to keep sulphuric acid corrosion within limits. Lead is often used when H_2SO_4 concentrations go as high as 96% at room temperature or as high as 85% at 220 degrees Centigrade.

When making equipment to handle H_2SO_4 within such ranges, lead will usually give you the most practical combination of corrosion resistance, simple fabrication, and reasonable cost. No common metal is easier to work than lead and it is economical, both in first cost and in maintenance.

With other corrosives the detail differs but the story is much the same. So when you think of corrosion resistance, think of lead and . . .

When you think of Lead . . . think of National Lead

WHAT GOES FOR LEAD AND H_2SO_4 GOES FOR LEAD AND HUNDREDS OF OTHER CORROSIVES

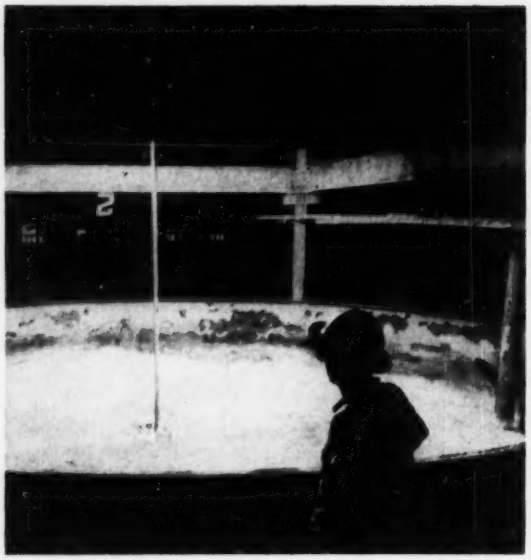
National Lead puts lead in your hands in any grade you may require and in every conceivable form — sheet, pipe, coils, fittings, valves, pumps and vessels. Or you can have National Lead fabricate lead equipment to your specifications.

So put National Lead first in your thinking when you want to combat corrosion. Call on National Lead for technical assistance. Ask for a copy of the new booklet on "Chemical Lead Products."

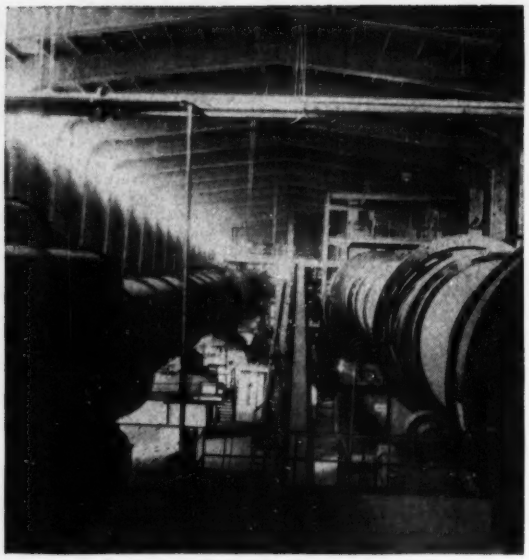
National Lead Company

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited).

*Reg. U.S. Pat.Off.



ALL COMMERCIAL plants, like Kaiser's, use bauxite . . .



BUT MANY, like the Bureau of Mines, try other ores as . . .

Eight Processes Vie in Alumina Race

Some are commercial successes, some are decidedly still in the planning stage, but all are aimed at bettering this nation's strategic position in alumina.

With the Bureau of Mines' $4.5 million alumina-from-clay plant at Laramie, Wyo., about to be sold to private industry, interest in alumina sources is again bubbling furiously. New processes are being explored, old ones tightened up at their engineering seams. And a lot of new faces are trying to get into the act.

At least eight techniques to utilize alumina-bearing ores are in the race, although only two are now used commercially. One of the eight charges only high-grade, mostly imported bauxite. The others, which are designed to lessen U.S. dependence on foreign sources, are for use on domestic raw materials—high-silica bauxite, various rocks and clays. In order for you to keep up to date, here, in brief, is the latest available information on all of them.

▶ **Bayer Plus**—Going an important step beyond the conventional Bayer process (see box, page 132), Alcoa at Bauxite, Ark., and Reynolds at Hurricane Creek, Ark., sinter the red mud residue to recover contained alumina and soda. This enables them to process domestic bauxite, which is so high in silica that use of the Bayer process alone gives only 70% alumina recovery. The combination process extracts about 90% of the alumina.

Feed to the Alcoa plant normally runs 50% alumina, 13% silica. The considerable red mud produced is washed, thickened to 50% solids and combined with soda ash (1.3 parts sodium oxide to 1.0 aluminum oxide). Limestone is also added (2.0 parts calcium oxide to 1.0 silica) and the mixture is ground in a three-compartment ball mill to a minimum of 90% through 200 mesh.

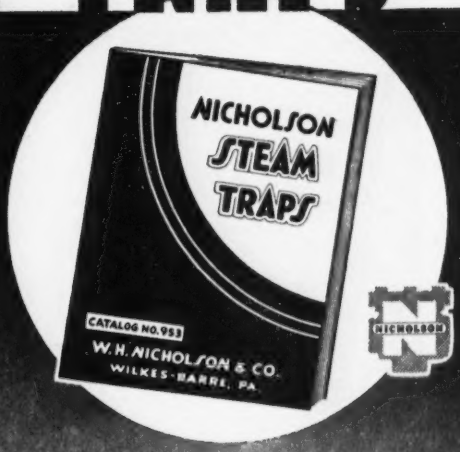
Sintering in rotary kilns at 1,800-2,000 F. follows, forming water-

These are the ways to make alumina

Raw Material	Process	Company Using or Developing
High-grade bauxite	Bayer	Alcoa, Reynolds, Kaiser
Low-grade bauxite	Bayer and red mud sintering	Alcoa, Reynolds
Anorthosite rock	Lime-soda sintering	Bureau of Mines
Clay	Electrolytic	Lobeth Corp.
Clay	Al-Si alloys directly	National Metallurgical
Clay	.....	Harvey Machine Co.
Clay	.....	Alcoa
Leached zone phosphate rock	.....	Alcoa

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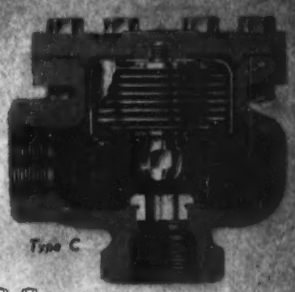
32-Page Reference Describes Advanced-Type Trapping Methods for Process Industries

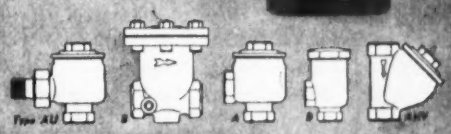
Nicholson furnishes a type and model of trap for every industrial process, power and heat application. For complete details you are invited to send for the helpful 32-page reference pictured above.

NICHOLSON THERMOSTATIC BELLOWS STEAM TRAPS

Nicholson thermostatic bellows steam traps (at right), distinguished for their fast positive action, are suited for critical processing applications. They are widely specified for continuous production and where advanced-type quality controls are in use, due to the high even temperatures Nicholson units effect and their minimum maintenance time and costs. Other advantages: above-average drainage capacity; will not freeze in operation. Specify the trap in the proper size to fit piping requirements: in 0 to 200 lb. range use type A, D, AU or AHV; to 250 lbs., use type B or C in semi-steel construction; to 300 lbs., use type C in cast steel construction. Bellows of bronze, monel or stainless.

A type for every Process, Heat and Power need. For pressures from 0 to 300 lbs.

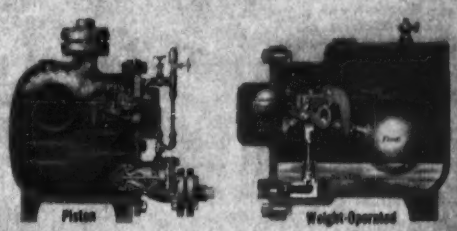




PISTON OR WEIGHT-OPERATED TRAPS

Nicholson piston-operated steam traps (right) have large capacity and are recommended wherever water is in volume; e.g., steam purifiers. Pressures: 2 to 650 lbs. Capacities: 12,500 to 552,000 lbs. Sizes: 1¼" to 2½".

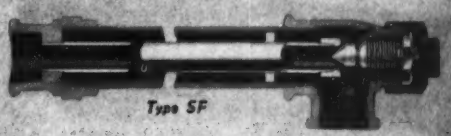
Nicholson weight-operated traps are heavy-duty types for draining steam, air and gasoline from separators, process vessels, dry kilns, accumulators, intercoolers, etc. Pressures: 23 ranges, 0 to 1500 lbs. Capacities: 1295 to 11,700 lbs. Sizes: ½" to 2"



THERMOSTATIC METAL EXPANSION STEAM TRAPS

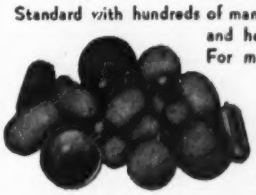
Nicholson expansion steam traps (right) require extremely low maintenance. Because they are readily adjusted to pass condensate at any point below 212°F, processing and refining plants have adopted these traps as low-cost temperature regulators on storage tanks which must be maintained at certain temperatures. Freeze-proof. Pressures: 0 to 250 lbs. Sizes: eight, ¼" to 2".

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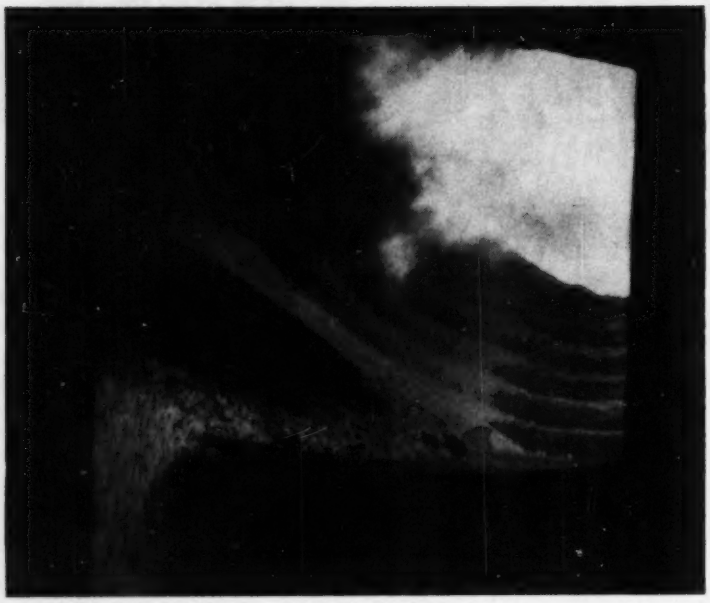


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SINTERED RED MUD leaves kiln at about 1,850 F., is then ground and leached.

soluble sodium aluminate and insoluble dicalcium silicate. This is ground and leached in wet ball mills and the resulting slurry is filtered and washed. The sodium aluminate liquor, being essentially the same as that in the digesters, is then introduced into the digesters and follows the normal Bayer cycle.

▶ **Bureau of Mines: Rock**—Bauxite is far from being the only potential source of alumina. Various clays and rock formations in the U. S. also contain significant amounts of alumina, and since early in World War II a number of concerted efforts have been made to discover processes for recovering it.

One of these is used at the Bureau of Mines' semicommercial plant at Laramie, Wyo., which charges anorthosite rock from large, near-by deposits. Government work there is now complete, and the General Services Administration is negotiating its sale to private concerns.

The process is a soda-lime sintering similar to that used by Alcoa and Reynolds, with two important differences. First, raw anorthosite is sintered as it's mined, while Alcoa and Reynolds use red mud from the Bayer process. Second, aluminum hydroxide is precipitated from the resulting sodium aluminate solution by carbonation at Laramie. In the combination process, the leach liquor from the sinter

Time Tested: The Bayer Process

Backbone of the industry today and likely to remain so for some time is the conventional Bayer process. It is best used on high-grade, low-silica bauxite such as is found in Dutch Guiana and the West Indies.

Kaiser's 800,000 ton-per-year plant at Baton Rouge is a typical Bayer operation.* Here, bauxite from Jamaica and Dutch Guiana is crushed and ground through 20 mesh, slurried with the process liquor—a solution of sodium aluminate, caustic soda and soda ash—and digested. Alumina (Al_2O_3) dissolves and aluminum silicates are converted to the insoluble sodium aluminum silicate. A small amount of lime must be added to prevent precipitation of P_2O_5.

▶ **Take Out Red Mud**—Digested slurry is flash cooled and insoluble residue—red mud—is removed by sedimentation in continuous thickeners. Starch is added to facilitate settling. Underflow from the thickeners goes through multicompartment decantation washers and the washed red mud is impounded in settling ponds.

Overflow liquor, after being cooled to 150-165 F., is mixed with seed aluminum hydrate and agitated for 1½-2 days. Sodium aluminate decomposes and about half the alumina trihydrate precipitates (see cut, page 130) before the precipitation rate drops below economical levels. Spent liquor and precipitate are pumped to classifiers where the hydrate is removed.

Coarse hydrate is washed on Dorrco filters, then calcined in rotary kilns at 2,000 F., yielding a product containing about 98.4% Al_2O_3 (dry basis). Multiple-effect evaporators are used to concentrate the spent liquor, which is recycled.

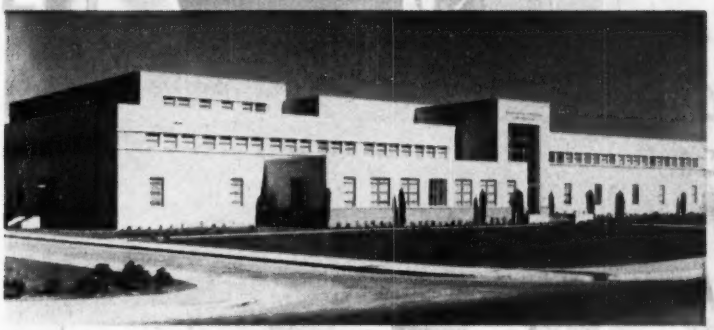
Kaiser makes its caustic by burning oyster shells to produce lime, which is then reacted with soda ash. Outside causticizing, as opposed to the general practice of causticizing in the digesters, makes it possible to reclaim and reburn calcium carbonate and also gives a higher caustic yield. Reynolds, on the other hand, buys caustic for its Corpus Christi plant. Whether to use caustic soda or lime and soda ash is strictly a matter of economics. Processwise, it makes no difference.

To make one ton of alumina by the Bayer process, Kaiser uses:

Bauxite	2-2.5 tons
Soda ash	200 lb.
Lime	140 lb.
Starch	3-30 lb.
Fuel	10,000-20,000 Btu.

* In the U. S., aluminum producers now using the straight Bayer process are Aluminum Co. of America (at Mobile, Ala.), Reynolds Metals Co. (at Corpus Christi, Tex.) and Kaiser Aluminum and Chemical Corp. (at Baton Rouge, La.)

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2879

is returned to the Bayer cycle. Here are the steps in the Bureau's process.

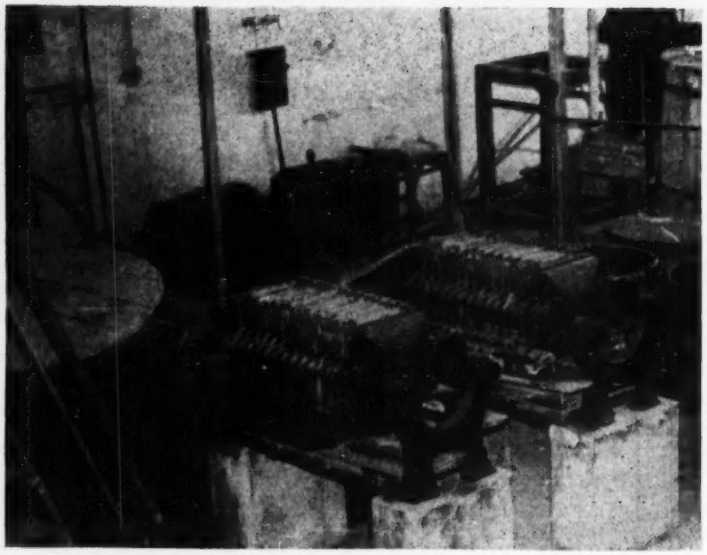
Anorthosite is mixed with approximately stoichiometric amounts of limestone and soda ash and sintered in a rotary kiln to produce calcium orthosilicate and sodium aluminate. The latter is then leached from the sinter in a weak soda solution. The small amount of silica also taken into solution is removed by adding lime and treating in autoclaves at about 320 F. Purified aluminate is then carbonated to precipitate aluminum hydroxide which is calcined to alumina.

The plant was designed to make 60 tons of alumina daily. But because of insufficient grinding capacity for the sinter, the maximum rate attained was 30 tons a day. However, Bureau spokesmen say that the process is definitely workable and with further refinement will consistently make alumina equivalent to that produced by the Bayer process.

▶ **Key May Be Cement**—An important by-product at Laramie is cement raw material—five pounds for every pound of alumina. And that may well be the saving grace, economically. Although no official figures have been calculated yet, alumina costs have been estimated as high as $75 a ton, compared with industry's direct production costs usually below $40 a ton.

It was no surprise, therefore, that two of the three companies that bid on the plant make cement. Monolith Portland Midwest Cement Co., which has a plant at Laramie, offered $600,000, would continue to operate the plant. Ideal Cement Co. of Denver bid $1,050,000 and pledged to keep the plant intact for two years so that the government could continue experiments. The third interested party, Harvey Machine Co., Torrance, Calif., offered $3 million, to be paid at the rate of $3 per ton of alumina made.

▶ **Lobeth: Clay**—The only non-bauxite process on which cost figures are available is the electrolytic process of the Lobeth Corp., Chicago. According to Lobeth, tests on a clay containing 10% alumina and 60% silica in a pilot plant near Genoa, Italy, indicate material and operational costs of $24.16 per ton of alumina, compared with $37.21 via the Bayer process. Extrapolated from Italian costs, it's claimed a 15,000 ton-per-year alumina plant using the technique would cost $2.25 million in the U. S. (which is 50% higher than the Italian cost).



BANK OF CELLS in Lobeth pilot plant electrolyzes aluminum sulfate to $Al(OH)_3$.

Here's what Lobeth does: Clay is pulverized and passed through a kiln (2,200 F.) which breaks down alumina complexes to alumina. The material is slurried with 60° Be sulfuric acid for about an hour and fed to a thickener. Ammonium ferrocyanide, lime and gypsum are then added to the aluminum sulfate overflow to precipitate iron as ferric ferrocyanide (Prussian Blue). Copper salts are subsequently recovered as metallic copper.

After a final thickening, the aluminum sulfate solution goes to a bank of electrolytic cells (50 cathodes, 51 anodes, 50 diaphragms). Here at 105-120 F. and 4-5 volts per cell, the solution decomposes—sulfuric acid coming off at the anodes for recycle, aluminum hydroxide at the cathodes. This passes to another thickener, where ammonium hydroxide is added, then is filtered. Finally the filter cake of aluminum hydroxide is calcined in a rotary lime furnace to alumina.

In addition to kaolin clay, Lobeth says its process can be used successfully on anorthosite rock similar to that used by the Bureau of Mines. The company has U. S. and Canadian patents pending and hopes to license the process to a U. S. firm soon.

▶ **Make Alloys Directly**—One company that's very much in the alumina field and yet does not plan to make alumina as such is National Metallurgical Corp. Formed by Apex Smelting Co. and American Smelting and Refining Co., its aim is to make intermediate aluminum-silicon alloys by direct reduction of domestic clay. To test their process they've built and have just begun operating a semi-commercial plant at Springfield, Ore.

Silicon is widely used to alloy aluminum for die castings. By conventional methods mixing of pure silicon and aluminum is rather tricky. Some of the difficulties, however, can be avoided by making an intermediate aluminum-silicon alloy directly from clay, using this as the alloying agent instead of pure silicon.

The National Met process is a modification of one tried in Ger-



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many about 30 years ago. The charge, mostly clay and hogged fuel, is fed into the open top of a three-phase, electric arc furnace. Alloys containing 5-60% aluminum and 95-40% silicon are tapped from the bottom.

▶ **Rounding Out**—Two other companies are also known to be working on alumina-from-clay processes—Harvey Machine Co., also interested in the Bureau of Mines plant, and Alcoa.

Early this year Harvey bought the government's alumina plant at Salem, Ore. Since then they've been installing new equipment and conducting small-scale tests on a process for alumina from low-grade clay. Industry feels that the process is probably feasible; it's now a matter of economics. In any case, full-scale production is still well in the future.

The same is true of Alcoa. The company has options on large parcels of laterite-bearing land in Oregon and has come up with a technically possible extraction process. However, it's not economical now and there are no plans for commercialization in the near future. In addition, large amounts of iron would necessarily be made and Alcoa has little interest in marketing iron.

Alcoa has also spent large sums of money on a process to extract alumina from leached zone phosphate—a large quantity of material lying above commercial phosphate rock in Floride. This leached zone is now waste because it's not economical to recover the phosphates in it. But the Atomic Energy Commission is interested because the zone contains uranium and this may well give added encouragement to companies experimenting with it.

▶ **The Road Ahead**—From the present economic and supply situation in bauxite, it seems safe to assume that processes for extracting alumina from other materials may have a long wait before they're commercialized. And there are many people in the field that think we should stop spending so much money trying.

Their reasoning is that it would be much cheaper and perhaps far wiser to spend the process development money on stockpiling of bauxite. With world reserves conservatively estimately at 3 billion tons, it would be relatively easy to build up even a 20-year inventory at very little over-all cost. In such a case, we could then use our present plants and avoid time and money wasted in throwing together new plants that would have to use new processes under emergency conditions.

General Aniline Plans More Chlorine-Caustic

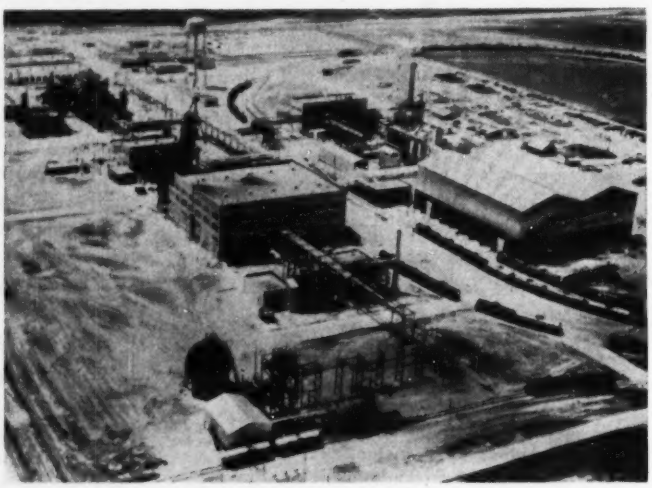
The capacity of a new chlorine-caustic plant planned by General Aniline & Film Corp. at Linden, N. J., has been revised upwards. Initially set for 26 tons of chlorine daily, the plant is now being designed to make 50 tons a day. Cost is expected to be $5 million (instead of $3 million).

At first it was thought that GAF would sell a portion of the output. But the anticipated increase in the need for chlorine at the company's Linden and Rensselaer, N. Y., plants makes it virtually certain that all the new production will be consumed internally.

No More Rayon From Du Pont at Buffalo

Moving to consolidate and economize its operations, E. I. du Pont de Nemours & Co. will discontinue all rayon manufacture at its Buffalo, N. Y., plant. Affected are high tenacity rayon yarn (Cordura) and rayon staple.

Shutdown of the staple operation, scheduled for April 30, 1955,



Allied Doubling Ammonia Capacity at Omaha

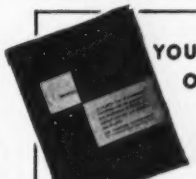
With full-scale production just barely started, Allied Chemical & Dye's Nitrogen Division is already planning to double ammonia capacity at its Omaha, Neb., plant (above). Built for $25 million, the unit was originally designed to make 75,000 tons a year of ammonia, about 90% of which is scheduled for production of urea. Initial ammonia operations began in April of this year; urea facilities came on stream in July. Allied is also expanding nitrogen products capacity at Hopewell, Va., and South Point, Ohio.



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YOUR CHOICE OF 7 TYPES

Sharples Bulletin 1259 describes briefly and graphically the complete line of Sharples Centrifuges. A copy will be sent for the asking.

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is based on the fact that it "is no longer economical as a result of the competitive situation and the lower priced staple being imported from abroad." As for Cordura, output of which ceases this month, "a reversion to normal civilian consumption of high-tenacity rayon has led the company to decide, for economic reasons, to consolidate production at its Cordura plant at Richmond, Va."

The Buffalo plant was the original home of Du Pont's rayon manufacturing, beginning in 1921 as Du Pont Fibersilk Co. Facilities were expanded in 1926, and the first rayon staple produced in this country was made there in 1927.

More than 1,000 workers are affected. About 200 will be retained or shifted to other jobs. The rest will receive severance pay and considerable assistance in finding other jobs. Production of film products at Buffalo, including cellophane and polyethylene, will continue.

Kodak Expands Distilled Monoglyceride Unit

Crediting growing customer demand, Eastman Kodak's Distillation Products Industries division has doubled its Rochester, N. Y., facilities for making distilled monoglycerides. These products were first pilot-planted in 1949 and went into commercial production at Rochester in 1952.

Monoglycerides are made from domestic fats and oils. Combining a fat, such as lard, with chemically pure glycerine yields a dilute form. Distillation then separates high-purity product from unreacted raw materials.

Biggest uses for distilled monoglycerides now are in margarine, shortening and ice cream. But DPI says they're also finding increased acceptance in cosmetics and paints.



Cars—Not Industry—Biggest Smog Source

In Los Angeles, anyway, oil refiners can no longer be pointed at as the major contributors to air pollution. Practically all the blame belongs on automobile exhaust, according to a recent report by Stanford Research Institute and the Western Oil and Gas Association.

Based on a six-year study by SRI, the report estimates that about 1,500 tons of hydrocarbons are discharged into the Los Angeles atmosphere daily. Automobiles contribute nearly 80% of this (1,180 tons) and almost 95% of the active hydrocarbons. Oil refining accounts for only 224 tons.

Stagnant air over the city and strong, enduring sunlight combine to give bad smog conditions. High concentrations of ozone (often five times greater than in most areas) are formed, resulting in unusual chemical activity.

One of SRI's test methods uses the trailer mounted equipment shown above. Exhaust gases emitted under various driving conditions are collected and completely analyzed within one to three hours.

News Briefs

Market research: To better serve its members and to reduce the burden on its elected officers, the Chemical Market Research Assn. has established permanent headquarters at 27 William St., New York, N. Y. It will be managed by Penn Affiliates, specialists in trade association management.

Pulp: Plans have been worked out by three firms to build a $30-million pulp mill near Edson, Alberta, with an initial capacity of 300 tons of bleached sulfate pulp daily. Participants are St. Regis Paper Co., New York, which will operate the mill, North Canadian Oils, Ltd., Calgary, Alta. and its subsidiary, North Western Pulp and Power Co.

Titanium dioxide: One of the largest titanium dioxide and sulfuric acid plants in the world will be built by the Glidden Co. at Baltimore, Md. The first unit, which will cost $10 million, is under construction. Eventually three such units will occupy the 100-acre site.

Sulfuric acid: Monsanto Chemical Co. has started building a 400 ton per day sulfuric acid (100%) plant at Monsanto, Ill. It will be of the Leonard-Monsanto type.

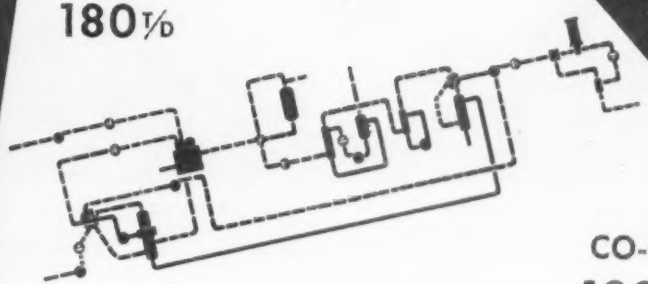
NH_3

design
and
construction

"know how"

Penna Salt ○
55 T/D

Deere ○
180 T/D



CO-OP ○
180 T/D

Conselho □
(Brazil)
100 T/D

Grace □
250 T/D

FOSTER WHEELER

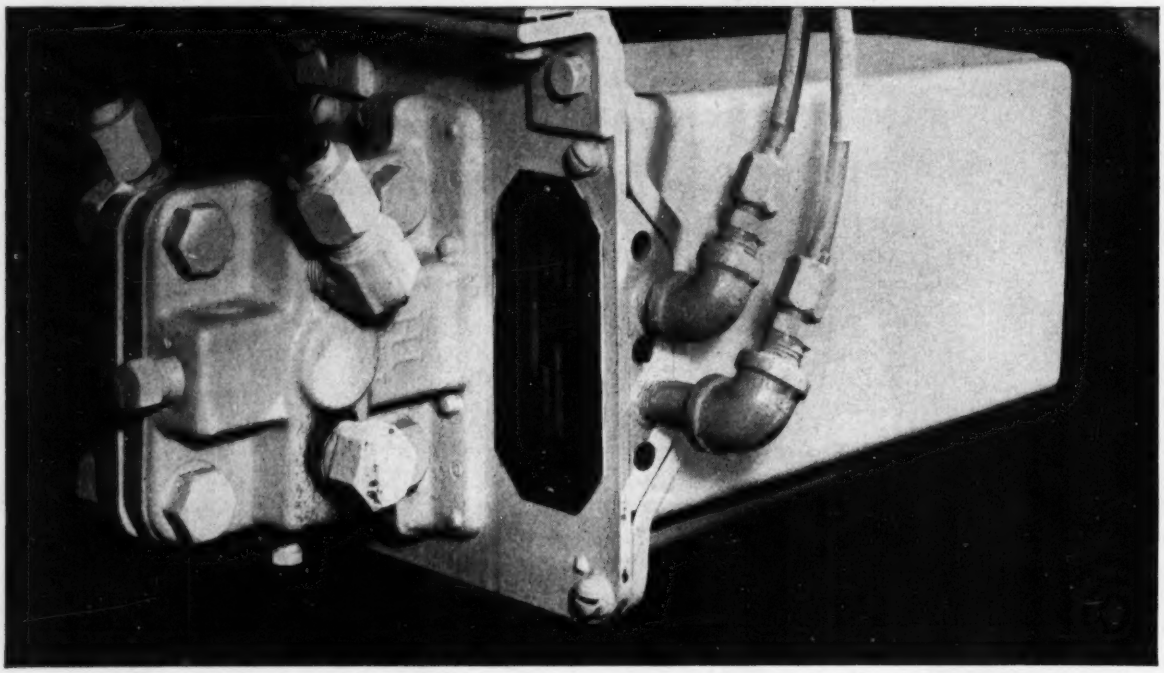
165 BROADWAY, New York 6, N. Y.

○ "on stream"
□ building

765 tons/day NH_3
"know how"

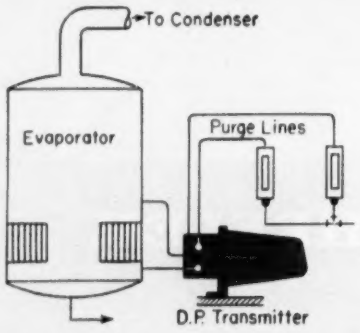
FW write for Bulletin G-54-1

GOOD FOR EVERY DAY



333RD Diff. Press. Transmitter measuring steam flow on a caustic evaporator at Montague, Mich. plant of Hooker Electrochemical Co.

AUTOMATIC PURGING OF SUSPENDED SOLIDS

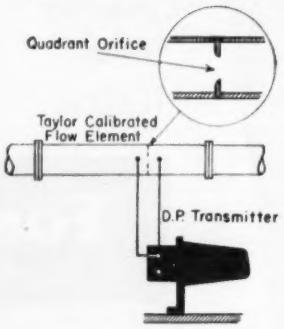


Problem: To obtain uninterrupted liquid level measurement and control where solids in suspension could settle out, plugging lead lines and causing errors in measurement.

Solution: Dual taps provide for complete flushing of the 333RD body as well as the lead lines.

Result: Consistently high accuracy. Flushing of manometer and lead lines cuts maintenance to a minimum. Evaporator efficiency is kept at a uniformly high level.

HIGH ACCURACY WITH VARYING VISCOSITIES



Problem: To get a high order of accuracy in measuring viscous fluids without special calibration curves and frequent changes in calibration due to troublesome variations in viscosity.

Solution: Its low volumetric displacement makes the 333RD transmitter ideally suited to capitalize on the improvements made possible by the recently developed European type quadrant orifice.

Result: Uninterrupted, accurate performance under difficult and variable viscosity conditions.

AND SUNDAYS TOO !

The Taylor TRANSAIRE® Differential Pressure Transmitter (333RD) is simple and economical, yet exceptionally adaptable!

THERE are three good reasons why this rugged, dependable and accurate instrument has become so widely used on so many different kinds of close-coupled fluid flow and liquid level measurement problem.

1. It's inexpensive and easy to install—and to maintain.

2. Changes in product or seasonal demand cause no problems, due to quick, simple range-change feature.

3. No seal pots. Follows flows quickly because of low volumetric displacement.

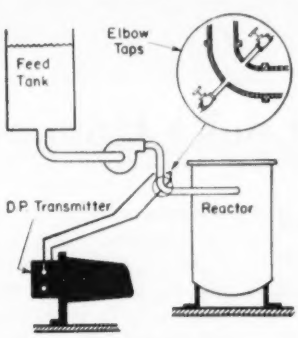
A pneumatic force-balance transmitter, designed to convert differential pressure into an equivalent 3 to 15 psi output, it can be used to measure flow of liquid, steam or gas; liquid level or specific gravity. Pressure rating is 1500 psi, and it's available in any desired range from 20" to 800" of water.

To find out how this versatile instrument can be put to work for you, call your Taylor Field Engineer, or write for **Bulletin 98097.**

Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Taylor Instruments MEAN ACCURACY FIRST

REVERSING FLOWS AND VARYING VISCOSITY

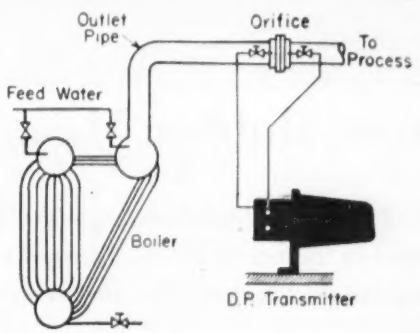


Problem: Flow control when there are changes in direction of flow and restrictions in the line are not desirable.

Solution: The use of the 333RD transmitter with Elbow Taps, as primary elements. Since there's a tendency to cavitation at the inside tap, the low volumetric displacement of the 333RD makes it particularly suitable.

Result: Accurate measurement, and consequently control, under very difficult conditions.

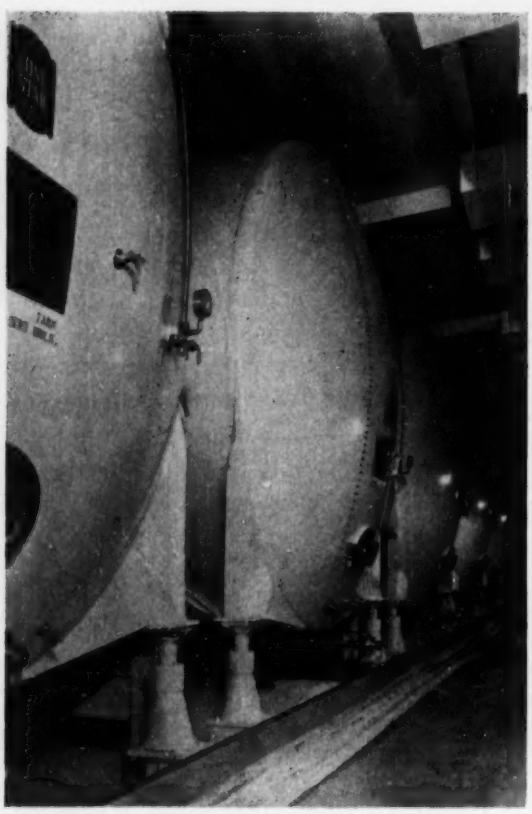
WHEREVER A GOOD "WORK HORSE" IS REQUIRED



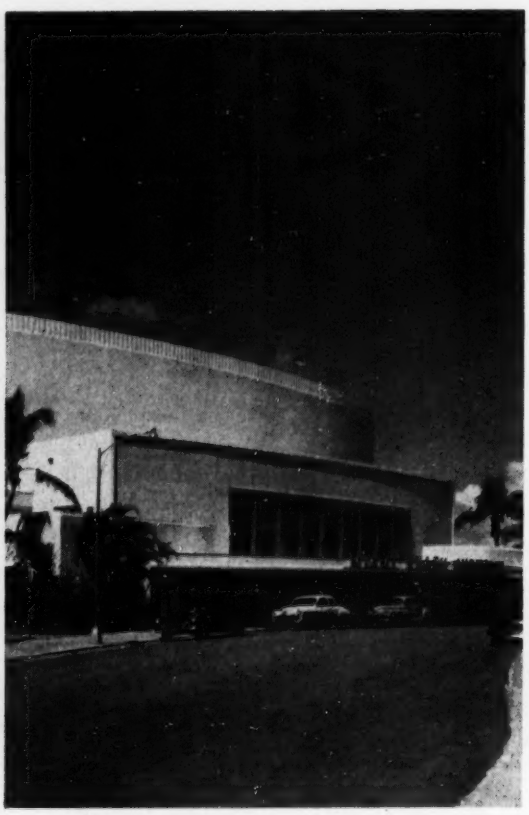
Problem: To eliminate expensive installation and maintenance of conventional flow instruments.

Solution: The simplified piping and light weight of the 333RD make it inexpensive to install. Maintenance is simplified by self-draining or venting feature. Range change is made by a simple sliding pivot—screwdriver trim. Low volumetric displacement permits rapid following of flows.

Result: Fast, low cost, trouble-free accuracy.



MAINTENANCE ENAMEL for a Chicago brewery.



MASONRY FINISH for a Miami auditorium.

Now, Rubber Masonry Paint Looks Homeward

Styrene-butadiene masonry paints are well established in industrial fields. Spurred by the building boom, they are driving hard for another prize: house exteriors.

Offshoot of wartime research of synthetic rubber, high styrene-butadiene copolymers have achieved a success of their own in industrial masonry paints, are poised for new expansion.

• First commercial copolymer paints were concrete floor enamels designed to overcome failures caused by free alkali and give maximum resistance to moisture.

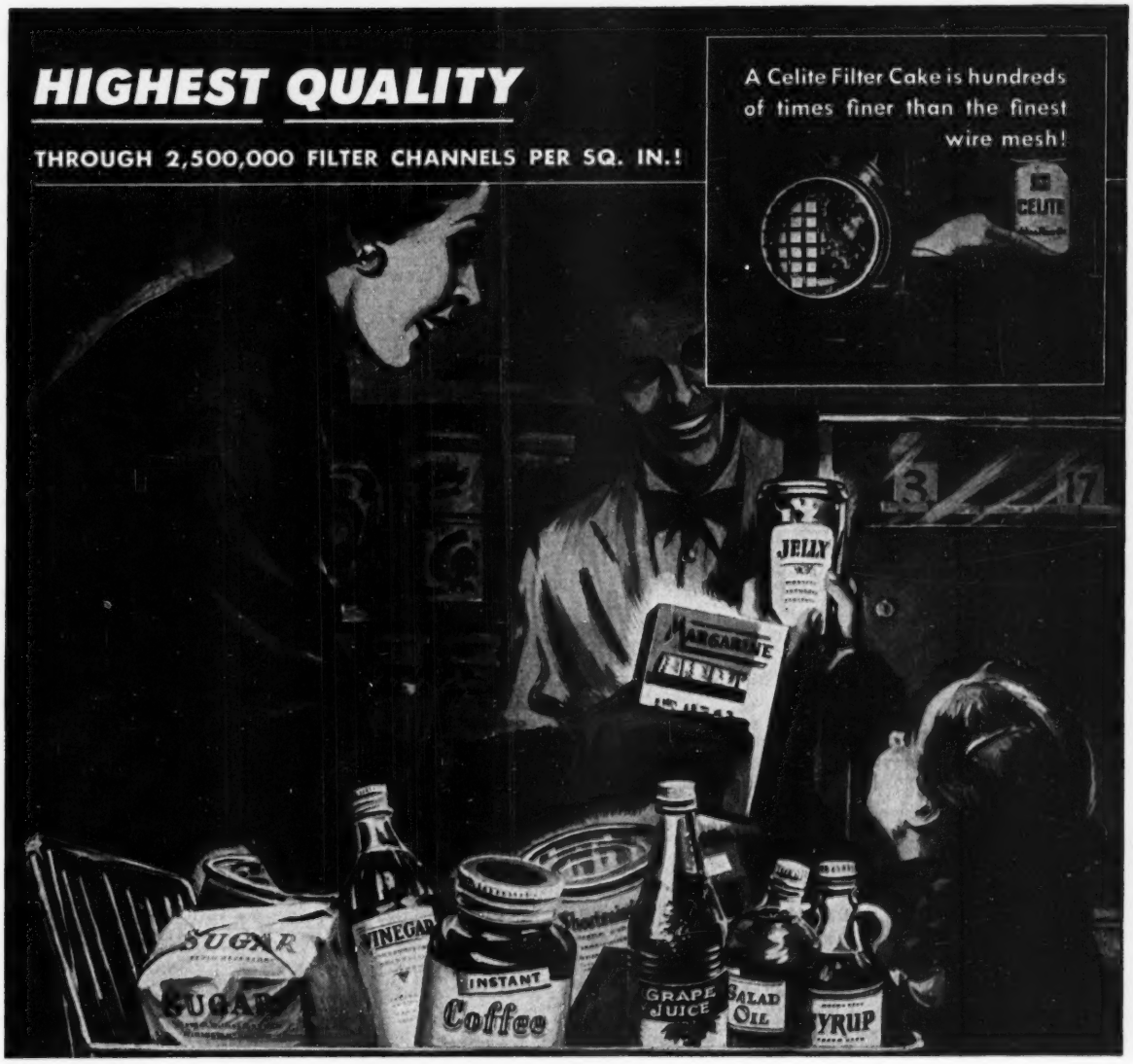
• Maintenance enamels for industrial plants, resistant to corrosive chemicals, soon followed.

• Tough, durable, weather resistant, these rubber resins were then put to work in exterior masonry coatings, their biggest present outlet and springboard for broader future use.

▶ **What's Ahead**—Today styrene-butadiene masonry paints are most widely used in the south and west because it is in these regions that stucco and concrete sidings are most popular.

But the tremendous country-wide housing programs of the past ten years, with their great emphasis on asbestos-cement shingle construction, have opened up a new land to masonry coatings: residential dwellings. This year the potential stucco-asbestos shingle market for masonry paint is estimated at nearly 7 million gal.

And with wood construction (on which SBC paints are of little value) falling off in recent years—and expected to keep slipping, albeit slowly—the grass looks even greener. SBC resins (acrylics and polyvinyl



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TO GIVE foods and beverages that extra quality which results in more sales appeal, leading processors depend on Celite Filtration. The Celite method provides perfect clarity at high production rates.

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A Johns-Manville Celite Filtration Engineer will gladly discuss the advantages and use of Celite in your product or production process. For his services, without obligation, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE INDUSTRY'S STANDARD FOR FINEST FILTRATION

Products on these pages this month made news . . .

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Rubber masonry paint.....142A
Masonry water repellent.....146A
Silicone rubber gum.....146B
Terpene chemical.....146C
Non-soap detergent.....148A
Vinyl coating keeps walls clean.....148B
Boost for rubber roads.....148C
Huge shipping containers.....148D
High density Fiberglas.....150A
Weed killer.....150B
Odor masking agents.....150C
Sunlight resistant nylon.....150D
Package well cleaner.....150E
Terramycin-hydrocortisone.....150F
Neoprene treated yarn.....150G
Sift-proof bag.....150H
Water-dispersible chlorobenzene.....150I

. . . For more about any item, use Reader Service postcard (p. 497)

acetates, too) are homesteading the territory already.

▶ **Why Use SBC Paints?**—Their most distinctive virtues are:

• They are resistant to the alkali present in fresh masonry surfaces.

• They are resistant to water yet can be formulated to permit the slow rate of moisture vapor transmission so vital to porous masonry coatings.

• They are resistant (good to excellent) to acids and alkalis, both weak and strong, to sunlight, soap, detergents, and to animal, vegetable and mineral oils.

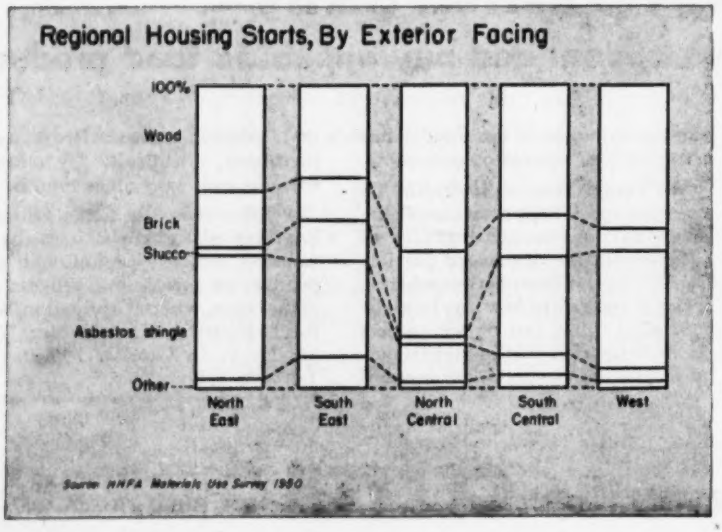
• They form hardy films on masonry that very rarely check, peel, pit, flake or crack. Failure is usually manifested in gradual disappearance of the film by chalking; thus, good repainting surface is always present. This chalking makes for self-cleansing action and a better looking paint job for a longer period of time. Careful pigment selection and formula design are necessary, however, to prevent too high a chalking rate.

▶ **Not Only Masonry**—In addition to usage in finishes for concrete, stucco, hot plaster, brick and asbestos-cement board, SBCs find smaller outlets as metal primers, plaster sealer primers and aluminum paints; as brewery, laundry and dairy paints; as wall paper coating (good scrubbability); and sand finishes, silk screen inks, etc.

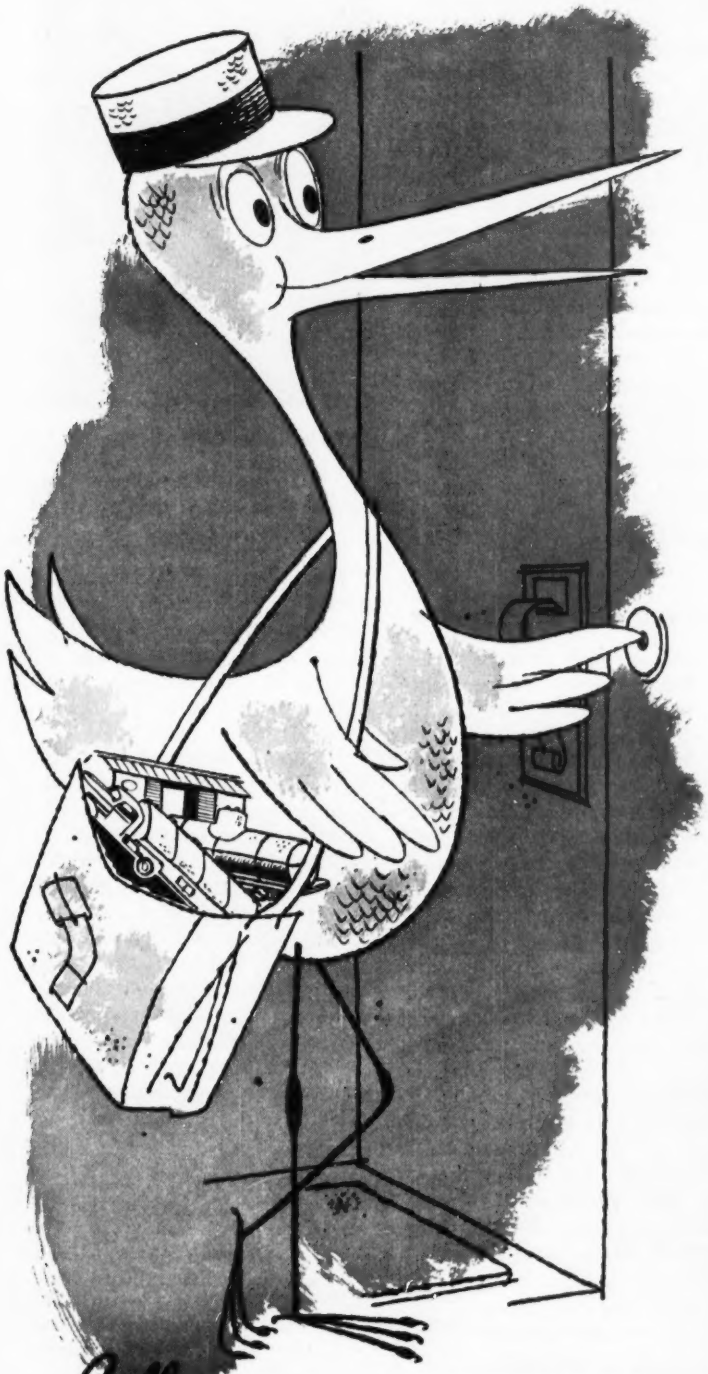
▶ **Twenty Years Ago**—Goodyear Tire & Rubber, one of the chief proponents of high styrene-butadiene copolymers for exterior masonry solvent paints made a rubber resin as long ago as the early 1930's. Called Natural Rubber Pliolite, it was a cyclized derivative of natural rubber produced by isomerization.

A hard resinous material, resistant to various chemicals and soluble in both aromatic and aliphatic solvents, Natural Rubber Pliolite began to gain favor as a vehicle for masonry protective coatings.

Then World War II pinched off the supply of natural rubber and forced the industry to synthesize substitutes. One of these synthetics, styrene-butadiene rubber, later looked promising as a paint vehicle



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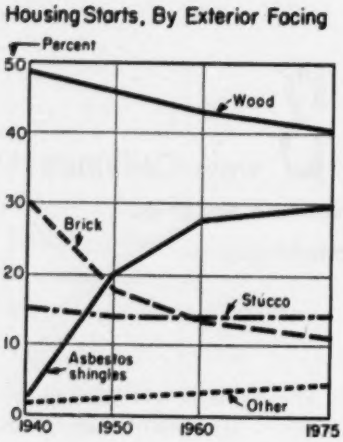
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in its own right. Styrene-butadiene isomers were tried first but soon yielded to directly produced resinous copolymers which proved superior counterparts to natural rubber in paint manufacture.

Pliolite S-5, Goodyear's synthetic resin copolymer, first appeared in 1946 at a cost of 65¢ a lb. Demand for it as a masonry solvent paint vehicle and better manufacturing processes make possible the present price of 49¢ a lb. in truckload quantities.

▶ **Styrene, 3 to 1**—Although made from the same raw materials used in synthetic rubber, styrene-butadiene paint copolymers are quite different in that the ratio of styrene to butadiene is 85 to 15* as compared with 1 to 3 for rubber. Altering monomer balance to this extent obtains both the film-forming and the handling characteristics required of a paint resin yet preserves rubber's chemical inertness.

▶ **Market Scanning**—Chart (p. 144): a regional breakdown of construction materials used on new homes started in 1950. Source: The Housing and Home Finance Administration's 1950 Materials Use Survey.

The chart shows how and where areas of asbestos shingle and stucco housing are developing, areas which are particularly attractive potential markets for SBC paint.

Chart (above) is a result of an extensive market survey conducted by Goodyear's Sales Research Dept., traces the recent history, and predicts the future course, of residential building in the U. S.

According to Fig. 2, the rate of new wood and brick construction is diminishing—and will continue to ease off, whereas asbestos shingle work is gaining rapidly and stucco holds its own. Goodyear estimates that by 1975 only 58% of the nation's residences will be of wood (today it's about 75%) and that 26% of all houses will have stucco or asbestos-cement sidings.

▶ **Scoreboard for Tomorrow**—From this and other survey data, Goodyear believes the potential market for exterior masonry paint for residential dwellings alone will be 10 million gallons in 1960 and, if you don't mind climbing out on a bit of a limb, more than 17 million gallons in 1975. **142A**

* Pliolite S-5's ratio. Competitive copolymers may differ, e.g. Dow Chemical's water emulsion latex for masonry which is 3 to 2 in favor of styrene.

Masonry Water Proofer

Silicone resin prolongs useful life of masonry, reduces maintenance costs.

Efflorescence, spalling and cracking of brick, concrete, mortar and other masonry surfaces are reduced by application of Dri-Film 103 silicone water repellent. Treated brick absorbs only 0.01% moisture after immersion for one week.

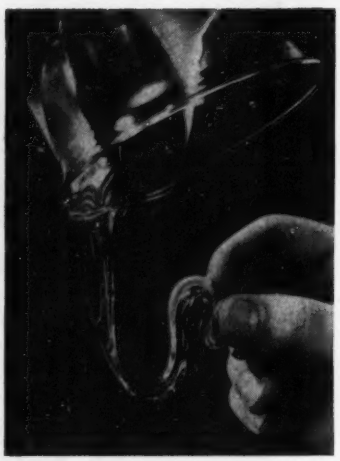
Peeling and flaking of interior walls is minimized since the new repellent resists the passage of moisture through the masonry and against the inner wall paint. And silicones prevent water mingling with brick and mortar salts which causes white or yellowish salt deposits on outer masonry surfaces.

One gallon of a 5% solution of 103 covers 75-100 sq. ft. of most surfaces.—**General Electric Co., Pittsfield, Mass.** **146A**

For More Information . . .



about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Silicone Rubber Gum

Uniform, stable polymer can be processed to yield a variety of silicone rubbers.

Dow Corning 400 Gum, a dimethyl silicone polymer, helps fabricators and compounders put their know-how to good advantage in formulating silicone rubbers to meet customers' particular requirements.

Heating a blend of 400 Gum and certain organic peroxide vulcanizing agents converts the mixture to a cross-linked resilient mass. Inorganic fillers and additives determine essentially the physical properties of the finished elastomer.

The gum is clear, uniform and nontoxic, of high molecular weight and high viscosity. 400 Gum is easy to handle with conventional rubber compounding equipment, is stable in storage and requires no preliminary breakdown. — **Dow Corning Corp., Midland, Mich.** **146B**

Terpene Chemical

Allo-Ocimene is now obtainable in commercial quantites.

An unusual hydrocarbon material, Allo-Ocimene, which polymerizes readily and contains three conjugated double bonds is available in quantity now for a wide variety of possible applications as a chemical intermediate or modifying agent in unsaturated systems.

Allo-Ocimene-85 is a highly re-

ETHYL ALCOHOL
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DIBUTYL PHTHALATE
METHANOL
BUTYL LACTATE
NITROPARAFFINS
AMMONIA
ETHYL ACETATE
AMYL ACETATE
BUTYL ACETATE
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NP DERIVATIVES
BUTANOL
DIMETHYLAMINE
ACETONE
1-NITROPROPANE
2-NITROPROPANE
FORMALDEHYDE
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ALKATERGE®
NITROMETHANE
HYDROXYLAMMONIUM SULFATE
PENTAERYTHRITOL
MONOMETHYLAMINE
TRIBUTYL PHOSPHATE
DIETHYL OXALATE
2-AMINO-2-METHYL-1-PROPANOL
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HYDROXYLAMMONIUM CHLORIDE
HYDROXYLAMMONIUM ACID SULFATE
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INDUSTRIAL CHEMICALS

fined technical grade of the material, running approximately 80% Allo-Ocimene. Isomers and small amounts of miscellaneous monocyclic terpenes make up the balance.–**Naval Stores Div., The Glidden Co., Jacksonville, Fla.** 146C

Non-Soap Detergent

100% active compound is devoid of fillers, salts and builders.

Nu-D-Tergent, a patented organic non-soap detergent, removes a wide variety of soils by acid neutralization, wetting out, solubilization, displacement and emulsification. It is suitable for such uses as washing auto and truck bodies; cleaning concrete, asphalt, linoleum, hardwood and other floors; cleaning painted surfaces.

Concentrations of less than 1 oz. per gal. of Nu-D-Tergent show surface tensions of less than 30 dynes. The product dissolves rapidly in cool or hot water to form a clear, curdless solution (even in saline water).

Other virtues claimed: Nu-D-Tergent cannot harm hands, contains no free alkali, will not induce rusting of ferrous metals and is safe on all natural and synthetic fibers.–**Kelite Products, Inc., Los Angeles 12, Calif.** 148A

Boost for Rubber Roads

Tiny rubber pellets mix readily with asphalt.

Greater use of rubber-asphalt topped roads is likely as a result of the development of pelleted unvulcanized rubber which can be evenly mixed with asphalt at the road mix plant.

Previously asphalt and rubber had to be premixed at the chemical plant, and shipped, hot, in insulated tank cars or trucks to the construction site. This meant high transportation costs and limited the shipping range to a 24-hr. trip.

Now rubber, in the pellet form, can be shipped in bags or drums, stored at the asphalt plant and tossed into a mixing mill where it breaks down in 60 sec., spreading rubber evenly through the mix. And the new pellets cost only 26¢ a lb., about a third below the cost of Naugatuck's previous product.

Rubber-asphalt used as the top layer of a road keeps water from seeping down to the lower layers and causing cracks and ruts. Such topping also increases the road's load-carrying capacity; improves skid resistance by preventing asphalt oil from rising to the surface and causing a slick coating after a rain; and improves the bond between asphalt and stone aggregate.

6-12 lb. of pellets are added to a ton of asphalt to cover 13 sq. yd. of road with a 1½-in. layer.–**Naugatuck Chemical Div., U. S. Rubber Co., New York 20, N. Y.** 148C



Spray it on . . .

A white-pigmented vinyl coating promotes good housekeeping in a plant, reduces spray booth maintenance to a minor operation. Sprayed on wall surfaces, White Vincote dries quickly to a tough, white film, permitting paint, lacquer and enamel overspray to be peeled off easily. The product's tensile strength guards against film breaking off walls because of dirt-load. Its spreading properties cut down formation of pinholes in film through which paint seeps and adheres to wall.–Detrex Corp., Detroit 32, Mich. 148B



Peel it off

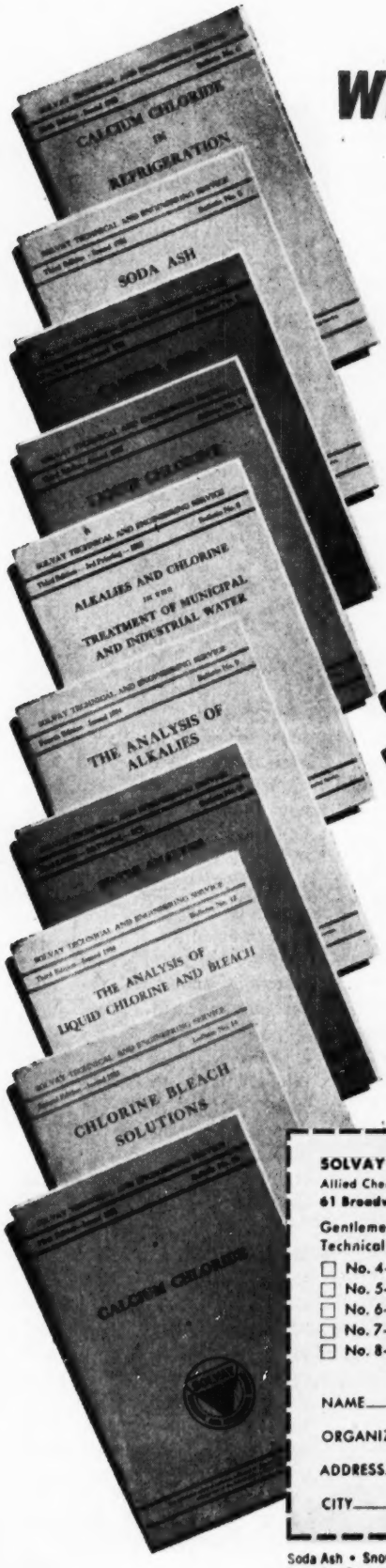
Big Shipping Containers

Carry up to 2,500 gal.; can be collapsed after use.

New bulk shipping containers made of synthetic rubber and fabrics are being used by leading companies to transport plastics such as polyethylene and polyvinyl chloride. Available in two sizes, 500 and 2,500 gal., they are also being widely tested for bulk shipment of carbon black, starch, clay, flour, sugar, malt, granular reclaim rubber and many corrosive and hygroscopic materials.

Exterior of the vessels, as well as the interior lining, is neoprene rubber which provides resistance to aging, vermin, leaks, weathering, abrasion and corrosive substances.

These "packages" can be shipped by barge, rail or truck; they can be stored outdoors or indoors at point of origin, in transit or at destination by the user; and they can be collapsed after use for storage or return shipment. Air or gas can be



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- ☐ No. 12—The Analysis of Liquid Chlorine and Bleach
- ☐ No. 14—Chlorine Bleach Solutions
- ☐ No. 16—Calcium Chloride

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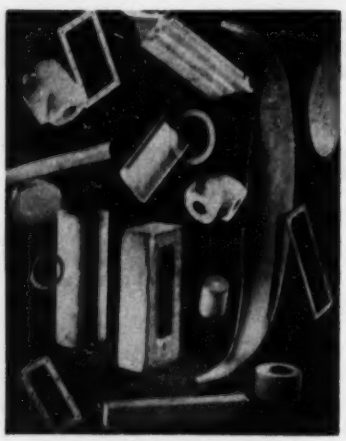
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pumped into filled containers to provide additional rigidity during handling. A six inch closure at each end eases emptying and filling.

The 500 and 2,500 gal. containers are 3 ft., 10 in. in diameter and 7 ft. high, and 8 ft. in diameter and 8 ft. high, respectively. Collapsed, they are 6 ft., 4 in. by 3 ft. by 10 in. and 8 ft. by 8 ft. by 2 ft. Manufacturers can lease both sizes at a monthly rate if desired.–**U. S. Rubber Co., New York 20, N. Y.** **148D**



High-Density Fiberglas

Molded product performs as shipping container, gasket, insulator, filter.

Molding uncured fluffy Fiberglas wool, together with a thermosetting binder, under heat and pressure creates a new, shaped type of glass with densities as high as 20 lb. per cu. ft. and structural strength coupled with resiliency. And, like other Fiberglas products, the molded grade will not burn, rot, absorb moisture, shrink and has thermal and acoustical insulating properties.

• Insulation: preformed, for piping. Although more expensive than asbestos-magnesia, molded Fiberglas affords big savings in labor costs. In addition, Fiberglas does not shrink or crack, is, in fact, resilient.

• Gaskets: wool sheets molded to high density and die-cut to shape. Fiberglas gaskets, unlike firefelt or asbestos gaskets, are completely handleable, can be bent repeatedly. Motor mounts to absorb endless vibration are similarly made.

• Shipping Cartons: 4,000 radar tubes ($350 each) have been transported in molded Fiberglas without breakage. One tube in every four was previously broken in transit.

Diversity of molded Fiberglas' uses is illustrated in the picture above. Included are gaskets, automotive instrument panel, air conditioner baffle, motor mounts, shipping containers, filters and preformed insulation.–**Owens-Corning Fiberglas Corp., Toledo 1, Ohio.** **150A**

Product Briefs

A weed killer, hexachloroacetone, has proved effective on Johnson grass and nut grass in experimental tests. Samples of HCA Weed Killer are now offered for country-wide evaluation with commercial production planned for next year.–**Allied Chemical and Dye Corp., New York 6, N. Y.** **150B**

New odor masking agents are commercially available to the petroleum industry. Alamask 0.19 and Alamask 0.20 improve the odor of No. 1 and No. 2 fuel oils. Recommended concentrations: 0.006% for No. 1 and 0.0085% for No. 2. –**Rhodia Inc., New York 17, N. Y.** **150C**

Sunlight-resistant nylon resin will prove useful in outdoor applications: agricultural machinery, marine hardware, electrical equipment, automotive parts. Zytel 105 BK-10 combines this resistance to ultraviolet degradation with nylon's other properties of corrosion resistance, toughness and light weight. **E. I. du Pont de Nemours & Co., Wilmington, Del.** **150D**

A "package" water well cleaner, Weltone, does a complete job of well maintenance by itself, requires no supplementary chemicals. Weltone contains Calgon water conditioner; a disinfecting agent; a wetting agent; and other compounds.–**Calgon Inc., Pittsburgh 30, Pa.** **150E**

Terramycin - hydrocortisone ointment, called Cortril Topical Ointment with Terramycin, provides a two pronged attack on a wide variety of stubborn skin ailments. Use of these two drugs together brings both inflammation (hydrocortisone) and infection (terramycin) under control at the same time. –**Chas. Pfizer & Co., Inc., Brooklyn 6, N. Y.** **150F**

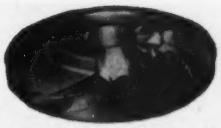
Neoprene-treated yarn yields fabric that can be washed and won't fray or pull apart when wet. This new yarn may recaptuure some of the fiber auto seat cover market lost to more expensive (and stronger when wet) plastics.–**E. I. du Pont de Nemours & Co., Wilmington, Del.** **150G**

A sift-proof bag, called Duo-Tite, is tailor-made for fine mesh, dry products hard to hold and four poisonous powdered products that must not sift. Duo-Tite, a double-lined bag, is heat-sealed at bottom, folded, paste is applied, and another fold made which glues to bag. The bag user can machine-produce the same heat-sealed, pasted closure at the top. – **Continental Can Co., New York 17, N. Y.** **150H**

Water-dispersible chlorobenzene solvent-cleaner and odor suppressant, Orthosolv, is first product of its type available at a practical price. Orthosolv removes: soft carbon deposits from motor parts; tars and oils from cars, trucks; oils and greases from concrete floors; grease and offensive odors from refuse containers and trucks.–**Solvay Process Division, Allied Chemical & Dye Corp., New York 6, N. Y.** **150I**

ALLIS-CHALMERS

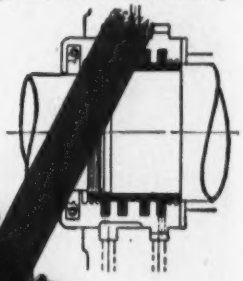
Multi-Stage Centrifugal Blowers



Impeller construction provides unobstructed passage of air or gas. Impellers are furnished in riveted or welded types, as determined by impeller dimension. Note that in riveted impeller wheels, rivets are integral with, and milled from, blade stock.

Impeller wheels are located accurately on shaft with sleeves and are mounted with light shrink fit. Bores are ground to size. Lock nuts prevent axial movement.

Sealing during operation is provided by oil pressure seals. A carbon ring seal prevents leakage when blower is not running.



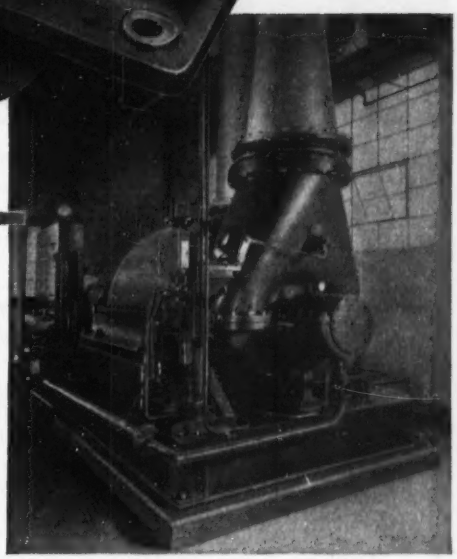
Load bearings are externally located for easy maintenance. They are split on the horizontal centerline for easy rotor removal. They consist of a cast-iron shell with removable, babbit-lined steel inserts.

Casing is heavy cast iron, alloy, or forged steel.

Why these blowers can run for years *without stopping*

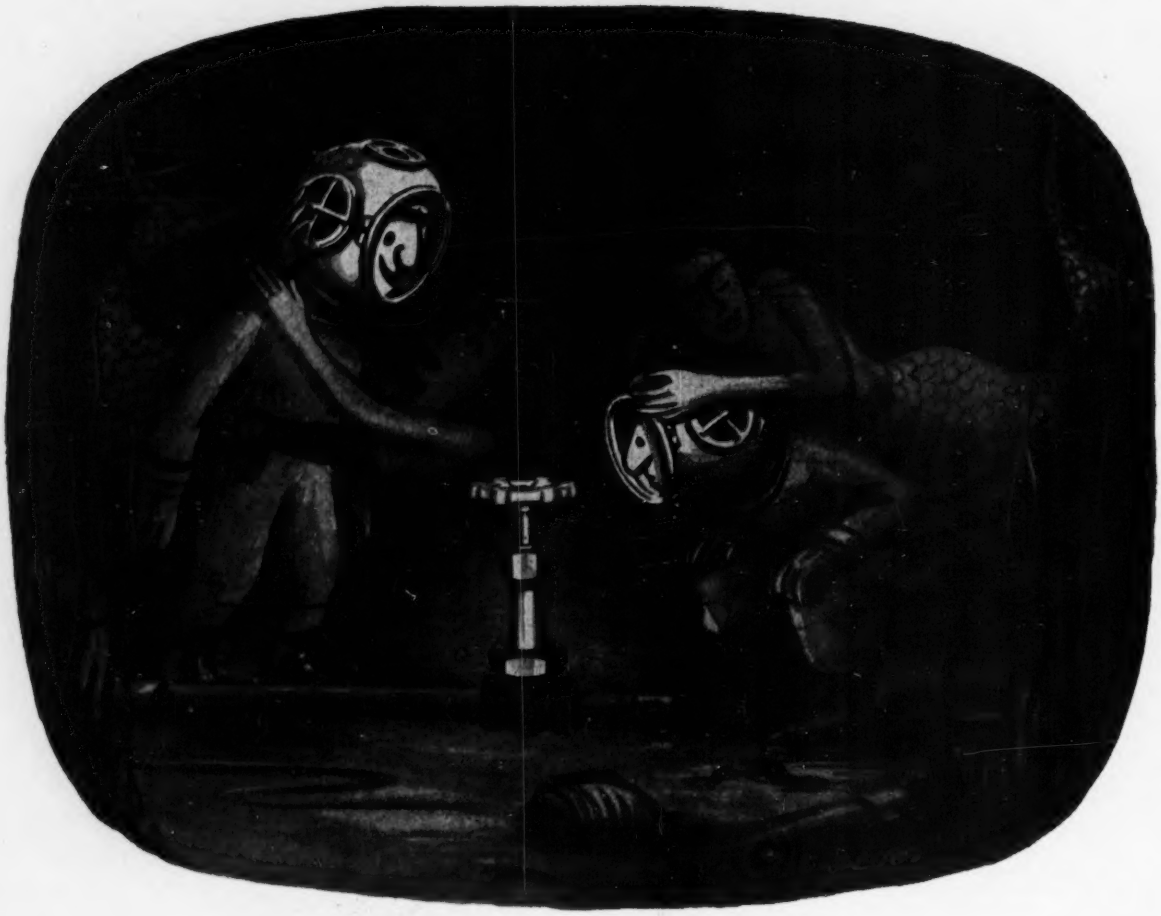
The key to "round the clock" performance of blowers in chemical plants is *quality*, as illustrated in the features above.

For highly dependable, low maintenance air and gas handling equipment, as well as motors and control, call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4471



This Allis-Chalmers four-stage centrifugal blower supplies 24,000 cfm to the catalytic cracking tower of an eastern refinery on a 24-hour-a-day basis, month in and month out.

ALLIS-CHALMERS A-C ALLIS-CHALMERS



"You see Powell Valves everywhere! And with . . .

. . . good reason! They're famous for dependability. Economical, too.
What's more, Powell has a complete line."

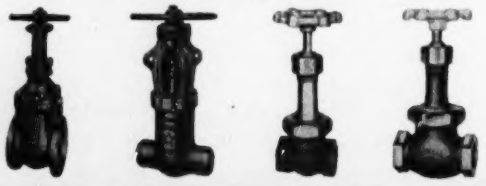
Just name the valve needed...

. . . POWELL CAN SUPPLY IT! Small wonder—since Powell probably makes more kinds of valves and has solved more valve problems than any other organization in the world.

Available through distributors in principal cities. In bronze, iron, steel and corrosion resistant alloys. ⅛" to 30" and 125 pounds to 2500 pounds W.S.P. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.



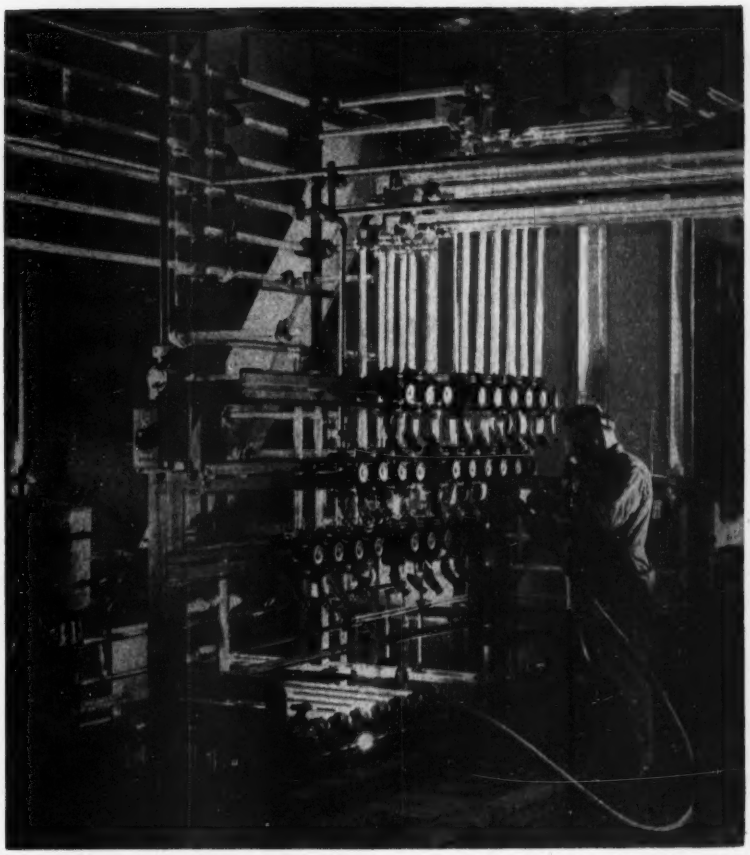
CONTROLS FOR THE LIFE LINES OF INDUSTRY



Powell Valves

108th year

This PYREX® pipe "Switchboard" does an unusual materials handling job



Operator at one of Merck's PYREX pipe "Switchboards" can cross-connect any of the glass pipelines in the manifold bank easily and quickly.

The pipes are easy to clean and can be quickly switched to handling any number of different chemicals.

If you toured the pilot plant of Merck & Co., Inc. in Rahway, N. J., you'd see this glass pipe "Switchboard" in action . . . speeding the progress of new products from research toward early production.

The system is constructed of one- and two-inch PYREX brand "Double-Tough" glass pipe arranged in circuits much like a telephone switchboard. Operators direct flow from various origins to a number of widely separated destinations just by adjusting valves located in pipe manifold stations similar to the one illustrated here.

This system provides the flexibility needed in handling the transfer of a constantly changing variety of chemicals from one processing stage to another. And Merck has constructed its PYREX pipe switchboard system so that it is instantly adaptable to handling materials with greatly different production cycles.

But why PYREX pipe?

Merck chose PYREX pipe for this complicated installation because only glass offers them all four of these necessary advantages:

1. *Non-Contamination*—PYREX pipe is chemically stable. It won't react with or contaminate the contents of the pipeline. It protects product purity.
2. *Corrosion Resistance*—PYREX pipe remains corrosion free even under the severest chemical service. It is unaffected by all acids except hydrofluoric.
3. *Clear Transparency*—Affords complete inspection at any and all points at all times. Trouble can't hide behind glass.
4. *Light Weight*—PYREX pipelines require a minimum of support.

Easy to clean . . . in place

A detergent run through PYREX pipelines followed by water or low pressure steam flushing, or both, generally removes all traces of past contents.

And PYREX brand "Double-Tough" glass pipe is durable. Experienced users report no breakage problems . . . even with operating temperatures as high as 250°F. In addition, PYREX pipe can be installed by regular plumbers or pipefitters.

Let us show how PYREX pipe can help you

Perhaps this Merck installation suggests some PYREX pipe application for your plant where greater corrosion resistance, improved product purity, or visual inspection can reduce your operating costs or give you closer quality control. Why not discuss your problems with the nearest PYREX pipe representative—or mail the coupon below for personal attention or further information.

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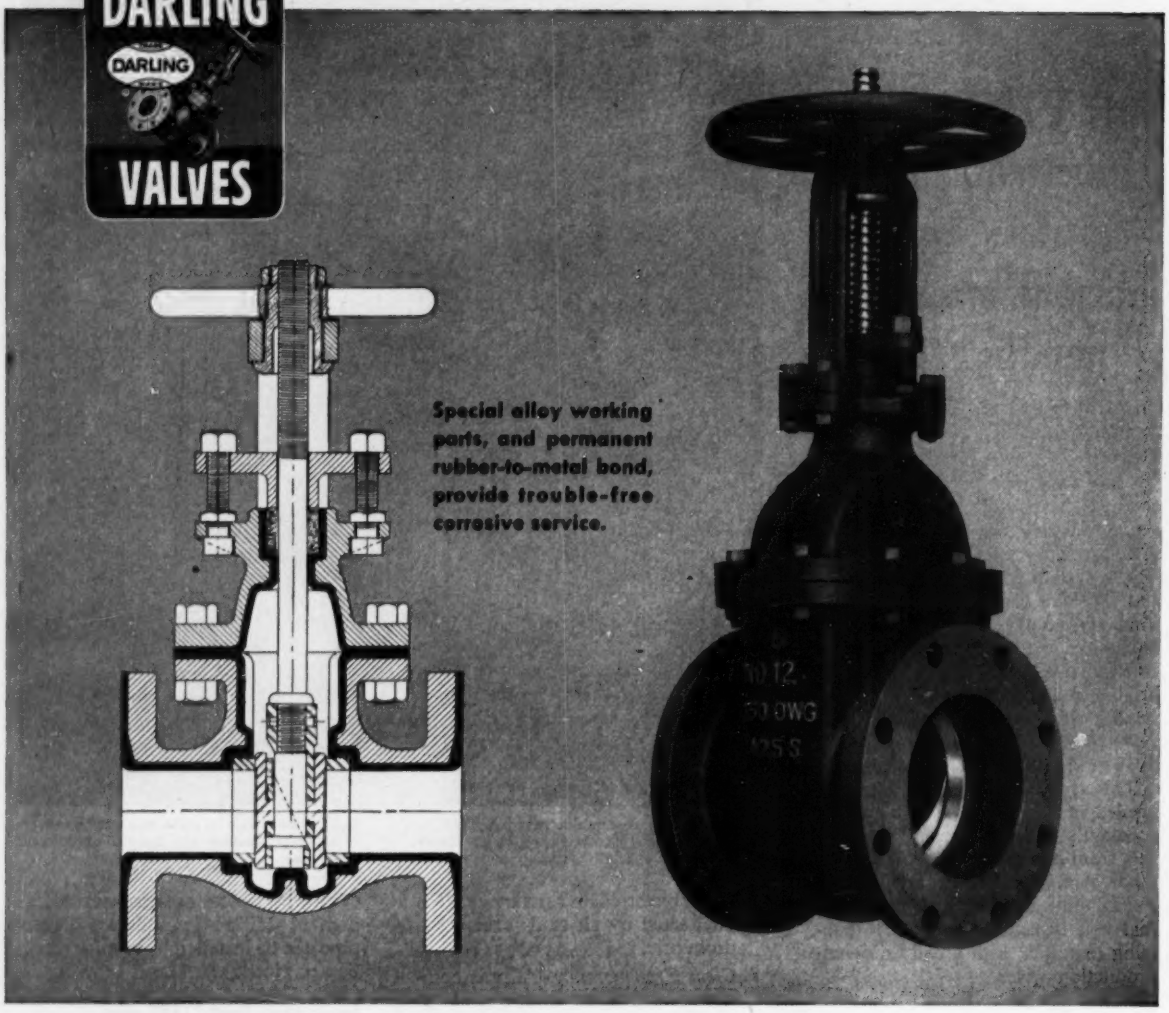
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"PYREX brand 'Double-Tough' Glass Pipe and Fittings" (EA-3) ☐ (A complete catalog)
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Please have a PYREX pipe sales engineer get in touch with me ☐

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Meeting the "Acid Test" the low-cost way with DARLING rubber lined iron body valves!

YOU can save dollars by installing Darling rubber lined, iron body gate valves for corrosive services up to 150°F. These Darling gate valves are giving outstanding service in job after job.

You Get This Plus Value Too!

The *fully revolving double disc,* parallel seat principle compensates automatically for valve body distortion. Tight closure is assured every time. And wear on working parts is *uniform.*

In plant after plant Darling rubber lined, revolving disc, parallel seat gate valves are setting records of efficiency and economy. These unique rubber lined valves are made in rising stem, cylinder, motor-operated, or quick-opening types.

Ask for the special Darling rubber lined *gate* and *check* valve bulletin.

VALVES FOR EVERY NEED

Darling also offers gate valves in a wide range of sizes, types and construction for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

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Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt, 19, Ontario



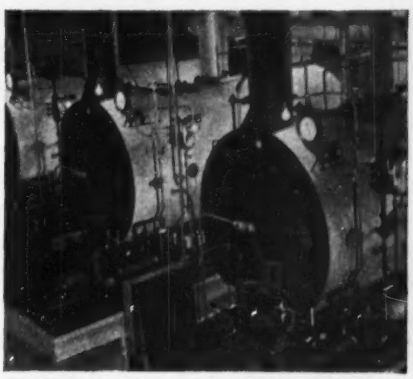
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One typical owner can count on yearly savings ($15,000 fuel and $10,000 labor) from this battery of three 150 hp Cleaver-Brooks self-contained boilers.

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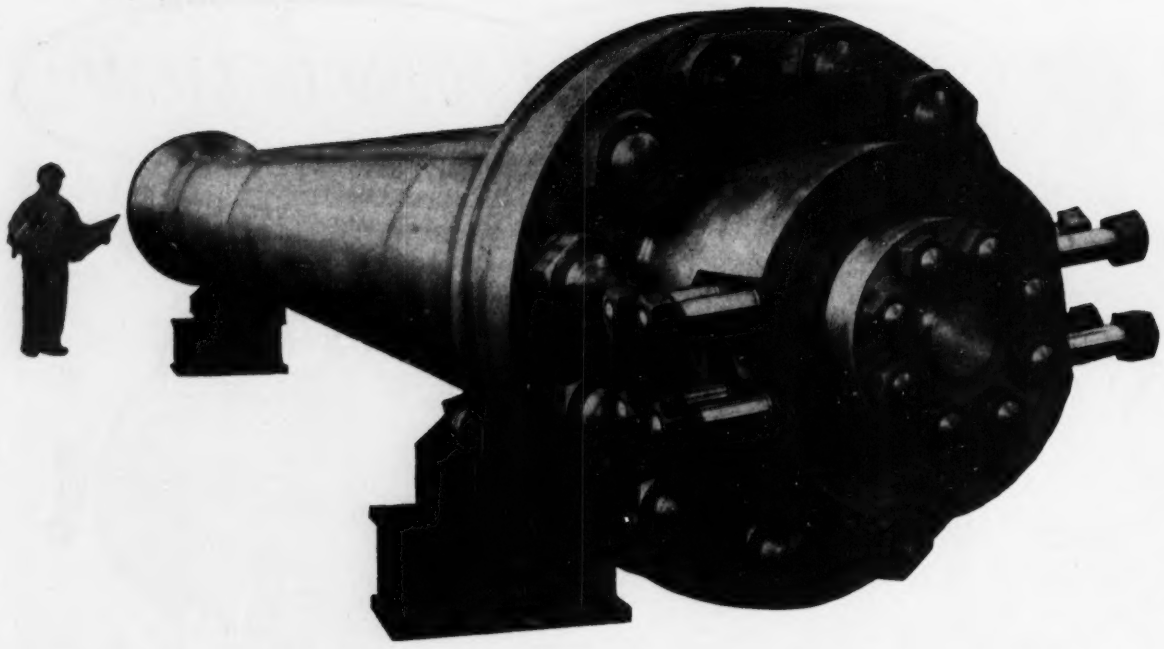
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ORIGINATORS OF THE SELF-CONTAINED BOILER

BOILERS . . . STEAM OR HOT WATER . . . FOR HEATING OR PROCESSING, IN SIZES FROM 15 TO 500 hp, 15 to 250 PSI.



This one helps make ammonia

Here's a Bethlehem forged pressure vessel built to be used in the making of ammonia. Weighing approximately 90 tons, it's what we consider a heavyweight unit. The main body OD is 42 in., the overall length more than 50 ft. Before we shipped it, the vessel was hydrostatically tested to pressures in excess of 18,000 psi.

Bethlehem builds some vessels that are larger, and some that are smaller. Even the little ones are very rugged units. Regardless of size, all are seamless for added strength and safety. Walls are thick; heads massive, with extra-heavy studs and nuts.

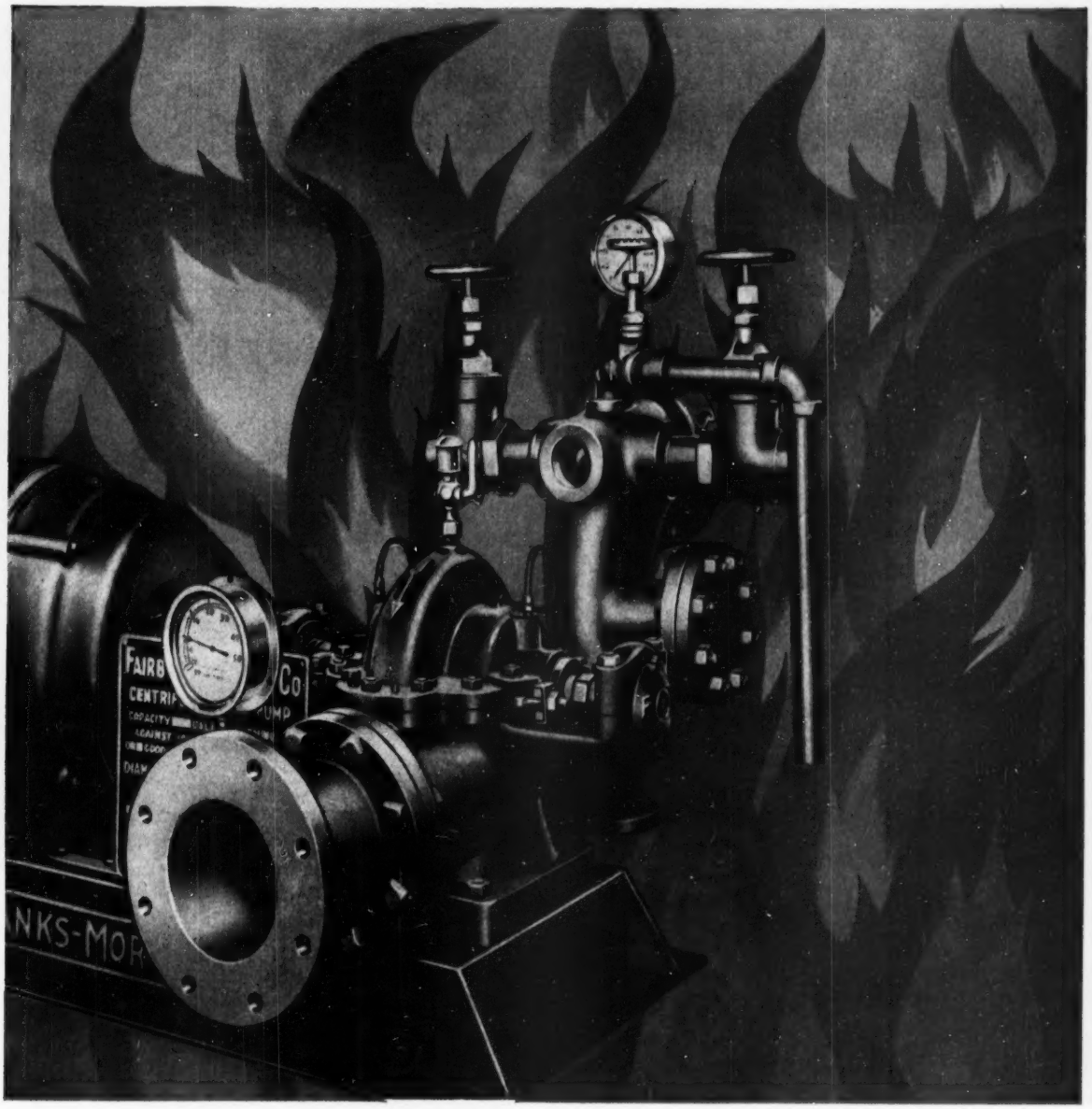
Naturally, ammonia isn't their only field of application. Bethlehem forged vessels are widely used in numerous types of chemical plants, and also in the rubber, petroleum, fertilizer, food-processing and allied industries.

Our engineers would like to show you what we have to offer—including our set-up for beautiful finish-machining. We can furnish you practically anything you need in autoclaves, reactors, converters, accumulators, separators, or filters. Why not call us?

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Bethlehem Forged-Steel Pressure Vessels



may you never need it . . . but . . .

. . . if you do, this is the fire pump you can depend on, Fairbanks-Morse. And where else is quality, dependability more important than in a fire pump. True, they may never be called upon . . . true, they may operate but seldom, but when they are needed, they *must* be ready.

That is why no design, material or manufacturing step that can contribute to reliability . . . to unfailing operation . . . is overlooked.

That is why we say "may you never need it, but this pump will always be ready if you should."

For the fire pumps you can depend on, contact your nearby Fairbanks-Morse Branch, pump dealer, or Fairbanks, Morse & Co., world's largest manufacturer of a complete pump line, Chicago 5, Ill.

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a name worth remembering when you want the best

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DE LAVAL *CONTINUOUS* SEPARATION IS PAYING BIG DIVIDENDS!



Chemical and food manufacturers—with products ranging all the way from Albumen To Zymase—are proving that centrifuging with De Laval Separators and Clarifiers is the modern, *cost-cutting* way to make liquid-liquid, liquid-solid and liquid-solid-liquid separations.

De Laval Centrifugals have streamlined production for these manufacturers. Instead of slow, uneconomical batch separation by filters or settling tanks, they are getting fast, *continuous* separation—uninterrupted material flow—saving time and money.

In addition, there are many processes in which De Laval Centrifugals also improve the product by doing a *more thorough* job of separation or clarification.

De Laval Engineers have helped many manufacturers of chemicals, pharmaceuticals and foods remove separation bottlenecks from processing. They can do the same for you.

THE DE LAVAL SEPARATOR COMPANY
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DE LAVAL

FOR FASTER PROCESSING SYSTEMS

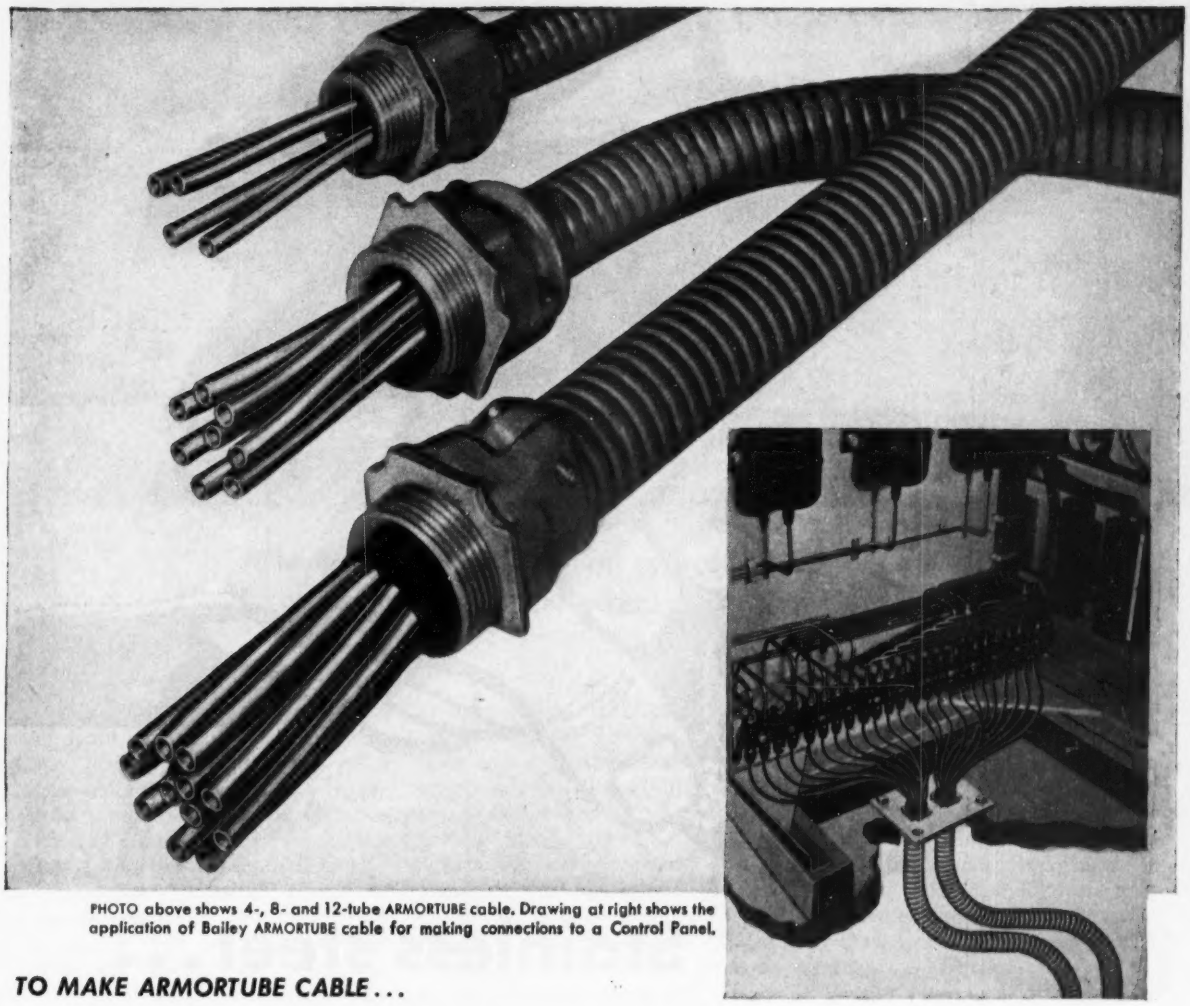


PHOTO above shows 4-, 8- and 12-tube ARMORTUBE cable. Drawing at right shows the application of Bailey ARMORTUBE cable for making connections to a Control Panel.

TO MAKE ARMORTUBE CABLE . . .

Bailey Meter Company turns to Anaconda for long lengths of ¼" O. D. copper tubes

Bailey Meter Co., Cleveland, Ohio, calls its ARMORTUBE Flexible Protected Tube Cable, "the modern shortcut to simpler, safer, more economical air and hydraulic circuits."

As shown above, this cable is available in bundles of four, eight or twelve ¼" O.D. copper tubes. A continuous, heavy galvanized steel strip protects the tube bundle.

Here's why Bailey turned to Anaconda as the logical source of supply for these ¼" O.D. copper tubes.

LONG LENGTHS

Because ARMORTUBE cable is shipped in random lengths of about 500 feet, Bailey needed long lengths of copper tube. Anaconda makes copper tube up to 2,400 feet long, depending on the diameter.

CLEAN INTERIORS

These tubes had to be free from dust, dirt or metal chips which might otherwise interfere with the operation of delicate air and hydraulic circuits. Anaconda takes special care to see that inside surfaces of ANACONDA Copper Tubes are clean, smooth and bright. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE

Tubes had to be flexible enough to bend around corners and obstacles. ANACONDA Copper Tubes are uniformly soft . . . highly flexible. And they are accurate in size and shape.

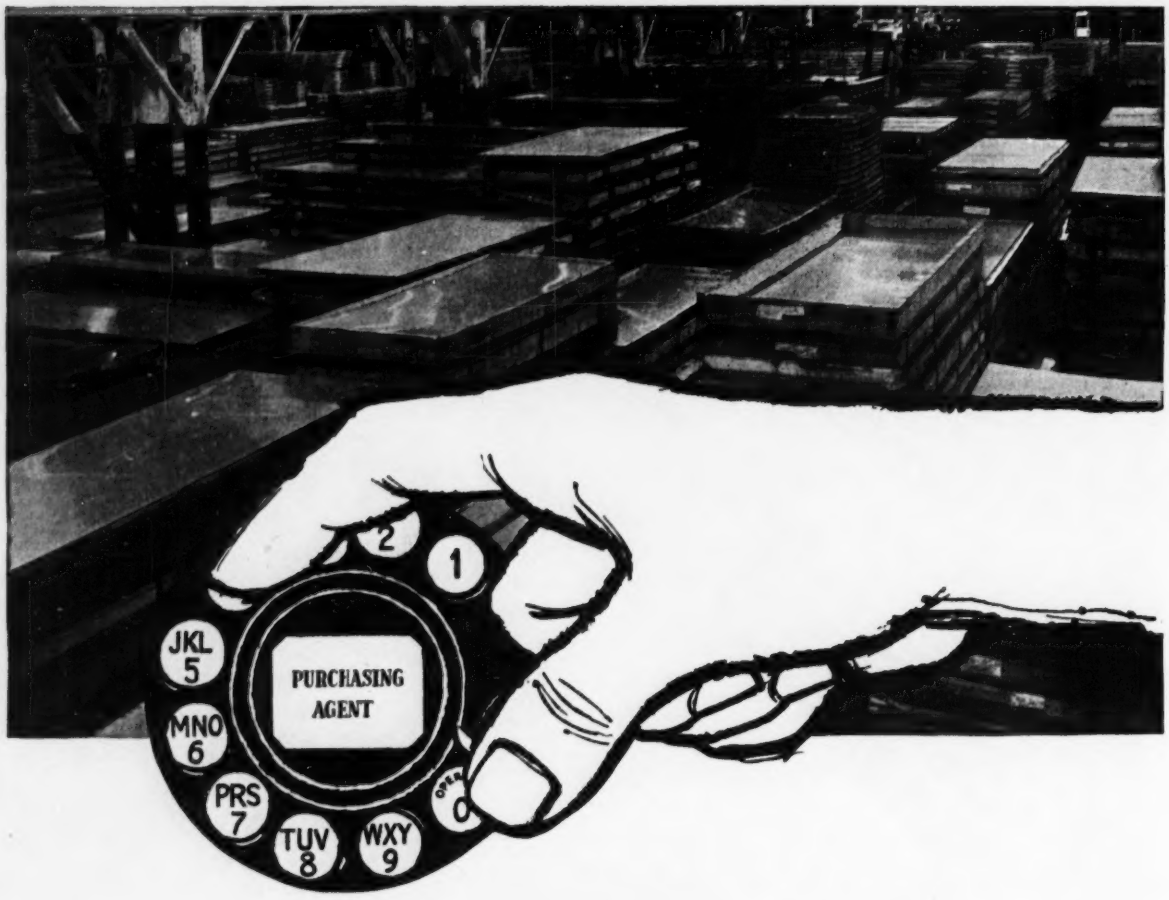
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Chemical Engineering
OCTOBER 1954

Ion Exchange

A CHEMICAL ENGINEERING REPORT

This much under-rated unit operation will go far beyond its present uses, as continuous operation and electrodialysis enter the picture.

NEVEN K. HIESTER and RUSSELL C. PHILLIPS

If you think of ion exchange only in terms of water softening, you're way behind the times. The adept chemical engineer will do well to consider this oft-neglected unit operation for a wide variety of applications; this report will bring you up to date.

Remarkable advances in ion exchange technology have been made since the first synthetic exchange resin was prepared by Adams and Holmes[1] in 1935. This unit operation can be credited directly for the high quality of many familiar products—television tubes, glycerine, streptomycin, sugar, storage batteries, paper, dyes and other fine chemicals.

ABOVE: *Cation exchanger Permutit Q; this and other photos (but not drawings) unless otherwise credited are from Permutit Co.*

Current applications of ion exchange extend from demineralization of tap water in a disposable cartridge (for a housewife's steam iron), to the softening of 80 million gal. of river water per day (for the city of Los Angeles).

Many chemical engineers neither appreciate nor understand ion exchange as a unit operation. They think first in terms of more familiar distillation and precipitation methods for solving their problems with ionized materials, and turn to ion exchange only as a last resort. A review of the current status of industrial applications and techniques, with particular emphasis on recent developments, many not yet commercialized, should encourage consideration of ion exchange on an equal footing with traditional unit operations.

As an aid in preparing this report, the authors submitted a questionnaire to 50 companies known to be active in the field of industrial ion exchange. Topics in the questionnaire included types of equipment and exchange materials offered, present and future applications, and new developments in the field. The 32 replies were compiled and used as a guide in determining the emphasis to be placed on each aspect of ion exchange.

Thanks very largely to the availability of new exchange materials, ion exchange although initially limited to water softening, now performs yeoman service in many diverse fields. In industrial water treatment alone, ion exchange is commonly used for demineralization, alkalinity reduction and silica removal. Removal and recovery of metals, acids and bases; separation of ions; de-ashing of or-



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Nevin K. Hiester, senior chemical engineer at Stanford Research Institute, Stanford, Calif., took his BS and MS degrees at University of Washington and his doctorate at University of California (Berkeley), for research on ion exchange. Joining SRI in 1949, his work has been diversified, but mostly on ion exchange; he has also taught it as a graduate course at Stanford University. With fellow staff members at SRI and others in the field he has written numerous papers on ion exchange theory and design.

Russell C. Phillips, associate chemical engineer at SRI, obtained his BS at Michigan State and his MChE at Brooklyn Poly. After six years in industry he joined SRI in 1951, where he has co-authored many of the ion exchange papers.

Both authors are anxious to credit Elliot Schrier, our western editor, who worked closely with them on this comprehensive report. As Dr. Hiester writes, "Without his cooperation I'm sure we should have been unable to prepare it."



RUSSELL C. PHILLIPS

Table I—Operating and Investment Costs*

Method	1,700 Ppm. NaCl (Slightly brackish) Oper.	Invest.	8,300 Ppm. NaCl (Brackish) Oper.	Invest.	33,000 Ppm. NaCl (Seawater) Oper.	Invest.
Electrodialysis	0.33	21.4	0.67	50.3	1.50	128.9
Vapor compression distillation	0.92	200	1.46	269	1.67	274
Ion exchange	1.17	188	....	.....	....	.....
Solar energy distillation	3.04	2,250	3.04	2,250	3.04	2,250

* Dollars per 1,000 gal., for demineralizing waters of various salinities (based on production rate of 10,000 gph.)

ganics; and catalysis of certain reactions are other processes in which ion exchange plays an important, though often not well-publicized, role.

Nor is ion exchange limited to reactions with ions dissociated in water; it can be utilized to remove impurities from non-aqueous systems such as liquid ammonia, acetone or benzene. The resins can also be used as acidic or basic catalysts.

In many cases, the end result of ion exchange may also be achieved by other unit operations. The engineer, seeking the most economical means toward his end product, should consider the technical and economic factors for each of these various alternatives. Demineralization of water, for instance, is possible by single- or multiple-effect evaporation, vapor-compression distillation, electromigration, and perhaps even by precipitation, as well as by ion exchange. Moreover, minimum costs may result from a judicious combination of these methods. Costs for several of these alternatives for several ranges of mineral concentrations are presented in Table I.

The cost of ion exchange is related directly to the quantity and species of the ions involved. The economics of each potential application must be determined independently. Especially since the advent of completely automatic equipment (for carrying out the normal sequence of cyclic operations), the largest annual cost item is usually the regenerant. Synthetic resins are expensive, but only small quantities are needed for replacement in most cases.

In general, ion exchange for water purification is limited to regenerant costs to the processing of dilute solutions (less than 2,500 ppm.). However, as the value of the material being processed increases, the economic limit of ionic concentration for ion exchange also increases.

Mechanism—The phenomenon of ion exchange has been known for a century, but the actual mechanisms have been elucidated only within recent years. This new understanding has paralleled—and may be the result of—development of the synthetic resin exchangers with their reproducible chemical and physical properties.

Consider the physical nature of ion exchange; it has been defined as "the reversible exchange of ions between a solid and a liquid in which there is no substantial change in the structure of the solid." This means that one of the ions is always bound to the immobile solid and is thus not carried away by the solution, a fact which embodies the principle advantage of ion exchange.

These interchanges can be written in normal chemical reaction form. Considering sodium chloride in water as an example:

For cationic exchange

$$Na^+ + H \cdot Resin \underset{\text{regeneration or elution}}{\overset{\text{treatment or saturation}}{\rightleftarrows}} Na \cdot Resin + H^+$$

For anionic exchange

$$Cl^- + Resin \cdot OH \rightleftarrows Resin \cdot Cl + OH^-$$

If the saline water is treated by both cation and anion exchange, neutralization of H^+ by OH^- results in demineralized water of a very low electrolyte content.

Within engineering accuracy, these equilibria seem to be governed by the laws of mass action,[3] i.e.,

$$K_{NaH} = \frac{(Na \cdot Resin)(H^+)}{(H \cdot Resin)(Na^+)}, \text{ etc.}$$

It is obvious that if the equilibrium constant for the cation exchange reaction shown is greater than unity, the resin will preferentially take up Na^+. This holds true for other ions, too. Thus, if K^+ is also being picked up from the solution by the hydrogen resin it will compete with Na^+ and, if its equilibrium constant with respect to H^+ is greater than that for the Na^+ exchange, K^+ will be preferentially picked up over Na^+. This relative takeup of ions on the resin, and the fact that they are transferred from the solution to a solid phase, are the reasons for the usefulness of ion exchange.

The relative order of takeup generally follows the lyotropic series,[3] i.e.,

$$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+ < Mg^{++} < Ca^{++} < Sr^{++} < Ba^{++} < Y^{+++} < La^{+++}, \text{ etc.}$$

The position of hydrogen depends on the strength of the exchange group; for sulfonic acid resins it is about the same as lithium, but for carboxylic acid resins, hydrogen exhibits a very high exchange power. The anion series is fluoride < chloride < bromide = iodide = acetate < molybdate < phosphate < arsenate < nitrate < citrate < chromate < sulfate[3]. Again, the strength of the anion exchange group governs the position of hydroxide; for a weak base resin it replaces sulfate, but for a strong resin it falls below fluoride.

The majority of industrial processes making use of these properties are concerned either with replacement of ionic impurities or recovery of desired ions from an otherwise non-ionic solution. The main factor then in these processes is removal of a certain ion and its replacement by a less important ion. An example is the removal of Na^+ from a solution and its replacement by H^+. Obviously, if K^+ had also been present it would have been removed even before Na^+, so it would automatically be taken care of by the proper design of an ion exchange unit for Na^+ removal.

The reverse, however, is not true, since resin tends to take up more K^+ than Na^+, so that nearly complete removal of K^+ could occur without all of the Na^+ being removed.

Although no industrial processes have made use of ion separation, which is the other main application of exchange resins, pilot scale units have separated amino acids and macroquantities of rare earths. The important factor here is the relative adsorbability of the two ions. Thus

in the case of the Na^+ and K^+ the exchange resin would preferentially take up K^+, so that Na^+ would be enriched in the solution. Continued operation of this principle would further enrich K^+ on the resin and Na^+ in the solution so that the ions could be separated.

Exchange Materials

With the exception of inorganic zeolites and sulfonated coal, all commercial exchangers are based on synthetic resins. These are homogeneous gels containing ion-active groups attached to a cross-linked molecular network.

Ion active groups make the linear polymers to which they are attached soluble and chemically unstable. The requirements for insolubility and stability are met by cross-linking these polymers into a fish net skeleton. Higher degrees of cross-linking are associated with reduced solubility, less swelling in solution and a more impermeable gel (slower exchange rate). In practice, manufacturers design their resins to have the densest structure compatible with a satisfactory rate of ionic diffusion. If more exchange groups are introduced to increase the ionic capacity of the resin, swelling tendency and solubility are increased. So again a balance is obtained between capacity of the resin and its solubility.

The chemical structure of a sulfonated styrene resin cross-linked with divinylbenzene, is shown in Fig. 1. This is a high capacity, strong cation resin. A typical weak base exchanger is represented in Fig. 2.[4] This polymer contains primary, secondary and tertiary amines which give the resin a basic strength over a wide range, from pH 3 up to pH 8.

A wide assortment of ion exchangers is offered to industry by the four principal United States manufacturers: Chemical Process, Dow Chemical (distributed by National Aluminate), Permutit and Rohm & Haas. Most of these commercial exchangers are represented in Table II. (The important Wofatit and Levatit exchangers manufactured in Germany and those made by Activit in the Netherlands have not been included.) Table III gives a partial list of equipment makers.

Cation Exchangers—Of the natural zeolites, glauconite, or greensand, has been used most extensively for water softening. However, the synthetic zeolite, sodium aluminum silicate, has a considerably higher ionic capacity than the natural product. Applications of zeolites are limited to cation exchange in the neutral pH range. In effect, this means they are used almost exclusively for water softening. Millions of cubic feet of zeolites are presently in use and because of their low cost will continue to be used for small softeners.

Sulfonated coal has a slightly lower ionic capacity than synthetic zeolite, but it can be regenerated with acid as well as salt, and in this respect is an improvement over the zeolites. It has, in fact, a high acid efficiency, although it is not so stable chemically or physically as the synthetic resins.

The oldest sulfonated phenol formaldehyde resins have been replaced for the most part by medium capacity sulfonated polystyrene types, which have greater stability. The high capacity sulfonated styrene resins, however, are the workhorses of the industry.

Being less strongly acidic than the sulfonated resins, the carboxylic type is easily regenerated with acids, but it will not split salts of strong acids. Carboxylic resins are used principally in the exchange of large organic ions like streptomycin, and for reducing excess alkalinity. Carboxylic exchange capacities are the highest among the cation exchangers.

Phosphonic acid resins are intermediate in strength between the sulfonated and carboxylic types. They have excellent exchange capacities at high pH's and can be regenerated efficiently with acid.

Anion Exchangers—All anion exchangers are synthetic resin amines. In demineralization applications, a weak base exchanger is used to process the effluent from a strong cation resin bed, since these anion resins will not split salts. They have high capacities and can be regenerated with Na_2CO_3, NaOH or NH_4OH.

Strong base exchangers, on the other hand, will remove acids as weak as silicic and can be used for salt-splitting. They require caustic regeneration. Anion exchanger designations Type I and Type II (in Table II) refer to different classes of amine substituents on the polystyrene structure. Type I resins have better thermal stability (can be used up to 160 F.); application of Type II is limited to a maximum of 100 F. Where operating temperatures permit, Type II exchangers are preferred because of higher regeneration efficiencies.

Combined cation and anion resins are available for mixed bed work.

Special Resins—The rate of exchange is related to the particle size of the exchange material, being more rapid with smaller sizes (the exchange rate being governed by diffusion). However, the pressure drop is excessive through a bed of fine particles, so most synthetic resins fall in the 10 to 50 mesh range, which represents a compromise among reaction rate, pressure drop and ease of preparation. Yet special orders for tailor-made resins with unusual grain size or degrees of cross-linkage or chemical structure will be filled by most manufacturers.

Conventional ion exchange resins exhibit only moderate selectivity for

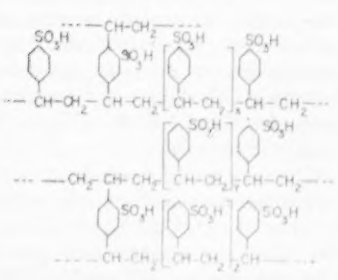


Fig. 1—Structural diagram of high-capacity sulfonated styrene cation exchanger.

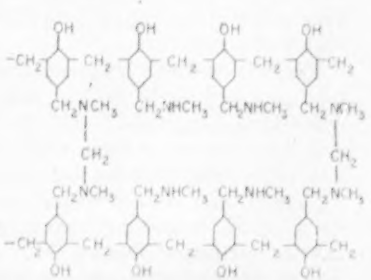
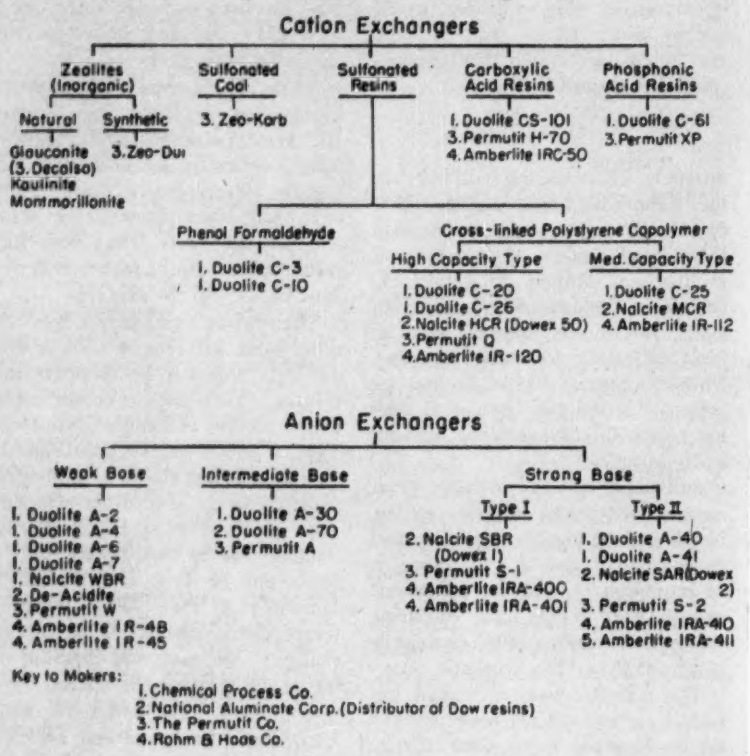


Fig. 2—Structural diagram of weak base amine-type anion exchanger.

Table II-Types and Principal Makers of Ion Exchangers



Note: The form of this table was adapted from one prepared by A. B. Mindler and C. F. Poulson of the Permutit Co.

ions. Chelating resins, on the other hand, exhibit marked attraction for specific ions such as cobalt, iron and copper.[5, 6]

A resin which has a selective affinity for potassium was synthesized by Skogseid.[7] Related in structure (except for the cross-linked polystyrene matrix) and action to hexanitrodiphenylamine, this resin can be used to separate potassium from sodium. Chemical Process Co. produces a zwitterion resin which contains both carboxylic and amine groups. Its chelating potential has not yet been thoroughly evaluated.

Electron exchange polymers have been produced which catalyze oxidation-reduction reactions.[7a] The most important feature of these resins is that, unlike other oxidizing and reducing agents, they do not contaminate the solutions. At least one commercial electron exchanger (Duolite S-10) is used to remove dissolved oxygen from water; it is regenerated with a sodium hydrosulfite-caustic solution.

Exchange Capacity

It is the practice in the ion exchange industry to designate the capacity of exchange materials in terms of kilograins of $CaCO_3$ per cu. ft. Although it will be used in this report because of familiarity, this designation leaves something to be desired.

For one thing, the expanded use of ion exchange outside the water softening field indicates the need for a more general (and fundamental) unit for exchange capacity. Since exchange of ions occurs on an equivalent basis, it is logical that capacity be expressed in equivalents per unit volume. Many research workers use meq./ml. of bed volume (= normality) as the capacity unit. (Note that 1 Kgr. $CaCO_3$/cu. ft. = 0.0458 meq./ml.)

The same problem occurs with solution concentration, where it is practice to speak of Kgr. $CaCO_3$/gal. although the research worker again prefers meq./ml. (1 Kgr. $CaCO_3$/gal. = 0.342 meq./ml.)

Manufacturers usually define the capacity of an exchanger in terms of regeneration method used; this is the so-called operating capacity. In research, the ultimate capacity is normally used; this is the highest capacity attainable under the most favorable regeneration conditions. Although the ultimate capacity is never utilized, it does provide a common basis for comparison of resins essentially independent of operating variables (concentrations, ion systems, bed expansions) and of the particle size of the exchanger.

Exchange capacities of synthetic resins although considerably higher than those of the natural zeolites, still impose limitations on ion exchange. Fortunately, ion exchange has established a very firm role in processing the many reasonably dilute solutions handled by the chemical industry. Moreover, it would be pessimistic to assume that maximum resin capacities have been attained.

For each application, the engineer has a choice of three techniques to bring about contact between exchange material and solution: batch, fixed bed and continuous. Because of its simplicity and effectiveness, the conventional fixed bed technique has been the method of choice in most cases. Simple batch methods, however, also have a place in the picture and, now that they have become available, continuous ion exchange units using conventional resins have to be considered as well—especially where high throughputs are involved.

Table III—Partial List of Organizations Offering Fixed-Bed Ion Exchange Units

Company	Industrial Softeners	Demineralizers	Mixed Beds
American Water Softener Co.	x	x	x
Automatic Pump & Softener Corp.	x	x	x
Barnstead Still & Sterilizer Co.		x	x
Chemical Equipment Co. of Calif.	x		
Cochrane Corp.	x	x	x
Culligan, Inc.	x	x	x
Dearborn Chemical Co.	x	x	x
The Dorr Co.	x	x	x
Elgin Softener Corp.	x	x	x
Enley Products, Inc.		x	x
Graver Tank & Mfg. Co. Inc.	x	x	x
Hungerford & Terry, Inc.	x	x	x
Illinois Water Treatment Co.	x	x	x
Industrial Filter & Pump Mfg. Co.	x	x	x
Infilco, Inc.	x	x	x
Los Angeles Water Softener Co., Inc.	x	x	x
Oshkosh Filter & Softener Co.	x	x	x
Penfield Mfg. Co.	x	x	x
Permutit Co.	x	x	x
Stover Water Softener Co.	x		
Western Filter Co.	x	x	
Wolcott Water Softeners	x	x	x
Worthington Corp.	x	x	x

Batch Exchange

Of the three major ion exchange techniques, the simplest as well as the first developed method, batch processing, has been least used. This is in part because a separation of the resin and solution must be made after the exchange is completed. But it is also because batch exchange usually does not remove enough ions in a single step.

Of the present processes of commercial interest, one has been used on a factory scale for a number of years in production of pectin from grapefruit peel.[8] Another interesting batch application, studied on a pilot scale, is the heart of a process to recover gold from pregnant cyanide solutions of a leach pulp prepared from ore.[9] Other commercial applications of batch exchange include calcium removal from milk, and catalysis.

Equipment

Much as one would expect, equipment used commercially for batch ion exchange has been adapted from ordinary stirred tanks and basket centrifuges already used in the process industries for contacting and separating liquids and solids. Along the same line, the stirred contactors and settling units normally used in hydrometallurgy for ore treatment were adapted for the gold recovery study.

Stanford Research Institute has developed a batch contactor on a small pilot plant scale that combines both agitation and filtration in the same unit and thus does not require movement of the resin, with possible resultant attrition. This unit can not be used in processes such as pectin production where an additional solid (i.e. the peel) takes part in both a batch ion exchange and a leaching step simultaneously.

SRI's individual mixer-settler consists of a tank with a perforated plate near the bottom to retain the resin, and a top and bottom outlet fitted with three-way plug valves, as indicated in Fig. 3. Considering the operating steps in sequence, the tank, containing a given amount of exchange resin, is initially empty of solution. To start the cycle, a definite amount of contacting solution is pushed into the mixer-settler by gas pressure. The gas flow, passing through the solution, agitates it and assists in bringing about equilibrium between resin and solution. Finally, the gas flow is reversed so that the solution is forced out of the tank and the resin freed of interstitial solution. The sequence can then be repeated.

This device can be regenerated in a similar manner, using elutant instead of feed. It can be used as a single unit, or a group of the mixer-settlers can be operated in a countercurrent fashion by automatic cycling and sequencing techniques. Details of such an operation are covered in Ref. 10.

Design

The most important factors to remember in the design of batch units are the time to equilibrium, and the solution-resin ratio. The rate of most exchange reactions, at least with the strong acid and base resins, is remarkably fast. In most cases this is only a matter of minutes under proper agitation conditions, so holding time can be kept short.

The limits of the solution-resin ratio are based on very practical considerations. With too low a value, say less than 9 gal. (1.2 cu. ft.)/ cu. ft. of bulk resin, the resin is in too thick a slurry to be easily agitated. The absolute slurry minimum is about 3 gal./ cu. ft. At high ratios the solution is not efficiently contacted by the resin during the equilibration period. The upper limit must be determined experimentally for the unit concerned but ratios of 110 gal./cu. ft. have been used in the SRI mixer-settler without difficulty.

As with all ion exchange techniques, the design method must take into account the equilibrium behavior of the ion between resin and solution, the rate at which the ion is transferred between the phases, and its conservation in the equipment. In any batch ion exchange the rate is usually of minor importance, except insofar as it affects time required for equilibration. Accordingly, normal design procedure involves only the equilibrium and material balance relationships.

Calculation of the behavior for single-stage batch units is rather straightforward. As indicated in Fig. 4, given amounts of resin and solution of known composition are placed in the contactor and equilibrated. (For removal of ion A from the solution the resin should be relatively free of A.) At the time of separation of the phases, component A in the resin is in equilibrium with component A in the solution. Further, the amount of A originally introduced to the reactor must be equal to that removed. From these two facts, the composition of the product solution can be obtained readily, although the explicit form of this behavior equation will depend on the form of the equilibrium relation.

If a set of these individual batch units is now operated in a countercurrent fashion as suggested above, this same method of calculation can be applied in a stepwise fashion, unit by unit. In the event that the equilibrium relation is linear, as in exchange with a minor ionic constituent

Nomenclature

(A^+)	Concentration of ion A (e.g., Na^+ or H^+) in solution.
$(A^+)^*$	Ion concentration in solution in equilibrium with resin concentration.
(A · Resin)	Concentration of A on ion-exchange resin.
d_P	Resin particle diameter.
D_F, D_P	Ion diffusivity in fluid or particle phase.
E	Ratio of slopes of equilibrium and operating lines $= HR_P/R_F$.
f_R	Void fraction in resin bed.
H	Trace equilibrium constant or slope of equilibrium line.
H	Error function.
N	Number of countercurrent equilibrium contacts.
r	Equilibrium constant function.
R_F, R_P	Volume flowrate, solution or resin.
Re	Reynolds number.
s	Number of transfer units for a fixed bed.
Sc	Schmidt number.
t, t', t_b	Solution capacity parameter.
V_F, V_P	Volume of solution or resin.
z	Argument of error function.
α	Constants in non-linear batch equation.
γ	Degree of approach to equilibrium transfer for ion in solution.
τ_F, τ_P	Residence time, solution or resin.

Subscripts

b	Breakthrough.
e	Completion of elution.
0	In feed.
None	Applied to concentration, at any time.

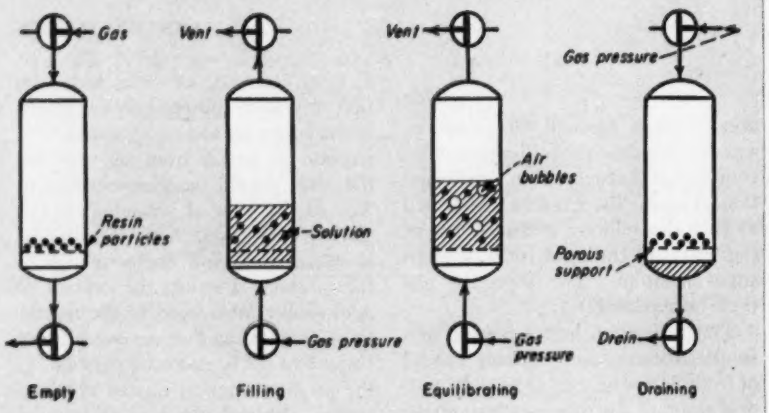
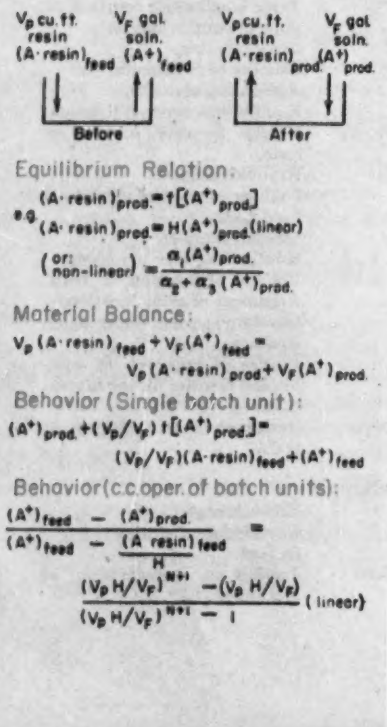


Fig. 3—Sequence of operations in a mixer-settler for ion exchange.

(usually known as trace conditions) the stepwise calculations can be avoided, since the behavior equation reduces to the one shown at the bottom of Fig. 4, where N is the number of countercurrent equilibrium contacts.

The main drawback to single-step batch exchange is that all of the ions can not be picked up by the resin, since as the solution concentration falls the resin concentration rises until they are in equilibrium with each other.

Fig. 4—Behavior of a single-stage batch ion exchanger.



The usefulness of this single-stage technique in ion removal is therefore limited economically to those applications having a very favorable equilibrium for ion A to go onto the resin. But this requirement can be offset by multistage operation—with its attendant increase in the need for equipment.

Where you have solids, as in the pectin or ore pulp processes, batch ion exchange may be called for, since even dilute slurries aren't easy to handle by fixed bed techniques. In batch operations, however, after the ion exchange reaction is complete, it is possible to remove the resin and solids from the solution and then separate them by normal procedures.

Applications

This ability to handle slurries suggests that one of the most promising fields for batch ion exchange is in hydrometallurgy for removing metal values from pulps. Filtration equipment and CCD systems are already available in most such plants and could probably be adapted for resin use. Experimental work in this field is certainly justified and is already under way.[11]

Fixed Bed Ion Exchange

At present the ion exchange industry utilizes fixed bed operations almost exclusively—although the beginning of a trend away from fixed beds is evident. Therefore, any discussion of ion exchange must cover this phase rather fully. The term "fixed bed" as applied to ion exchange means utilization of a packed column of stationary resin to process a solution in a cyclic manner. Strictly speaking, therefore, it also includes mixed bed and ion exclusion processes. Because fixed bed ion exchange has been almost the only contacting technique used in the past, convention has gone so far that the words "ion exchange" have often been taken to mean fixed bed operations.

Equipment

For removal or recovery of ions, the normal fixed-bed cycle comprises several steps: (1) treatment (saturation) of the exchange bed with raw feed solution, (2) backwashing of the bed to remove dirt and regrade the resin, (3) elution of the exhausted exchanger by passing regenerant solution through the bed and (4) rinsing the bed free of regenerant so it is then ready to repeat the cycle. Both Step 2 and Step 4 are usually relatively short parts of the overall cycle.

In this type of operation at least two units are usually provided to insure a constant flow of treated solution. An idealized case of water softening is shown in Fig. 5.

Here the degree of shading indicates the amount of calcium picked up by the resin. After Bed A is almost all converted to the exhausted form (calcium) and Bed B is regenerated to the sodium form, the valves are turned and the hard water sent to Bed B and the regenerant through Bed A.

When only two columns are used, backwashing and rinsing, if necessary, and regeneration, are undertaken while a bed is off stream. More columns can be used if these steps require excessive periods of time. In any event, this type of operation requires considerable complex piping and sequence valving to bring the proper solution to the proper unit at the proper time. Various schemes have been proposed in an attempt to overcome this requirement, but most of the schemes replace one type of complexity by another.

For example, Weil and co-workers[12] suggest that the resin bed be brought to the solution by having several columns arranged on a frame so that a fresh resin bed can be moved under the feed inlet. Barnebl and Riker[13]

propose using a horizontal rotary filter (Fig. 6)to hold the resin bed in a series of adjacent but isolated pie shaped chambers. The bed rotates under a number of liquid distributing stations arranged about the unit so that each chamber passes first under the feed solution, then a solution wash, then the regenerant and then a final wash including backwash.

A further step that might be taken in a device of this type would be to introduce the feed at the last position in the feed sector, then draw the spent feed from the bottom of this chamber and use it as a feed to the preceding chamber, etc., so as to add a feature of countercurrent operation. But it would add an even greater complexity to the rotary valve and require extra pumps and liquid distributing stations.

Still another type of fixed bed operation suggested by Rawlings[14] has been used to some extent. Here, a group of beds is operated in series with the most recently regenerated bed at the end, just as in an extraction battery for sugar beets. When saturated the first bed in the series is cut out for regeneration, and a fresh bed added at the end. This same technique can be used for the washing and elution steps, if desired, with as many units in each series as needed. It is obvious that this gives a quasi-countercurrent contact to each bed and thus increases its utilization efficiency. But it has the drawback of a large number of columns and a corresponding amount of complex piping, valving and sequencing equipment.

Although these various developments have certain minor advantages, the ion exchange design engineer has usually chosen normal fixed-bed operation. Most industrial installations are therefore standard two or three bed units.

Fixed-bed equipment is fairly standard in design, consisting of a cylindrical tank containing a bed of resin on a porous support as shown in Fig. 7. A solution collector under the support and a distributor above the bed are also necessary to prevent non-uniform flow which would result in poor resin utilization and regenerant efficiency. Flow of the feed through the column may be by gravity or under pressure, depending on the nature of the exchange process. Pressure operation in a closed vessel would prevent solution contamination and gas evolution ahead of a deaerator if these factors were critical.

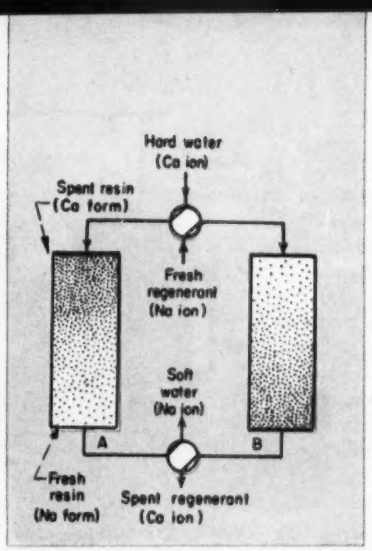


Fig. 5—Schematic diagram of a two-unit fixed-bed exchanger.

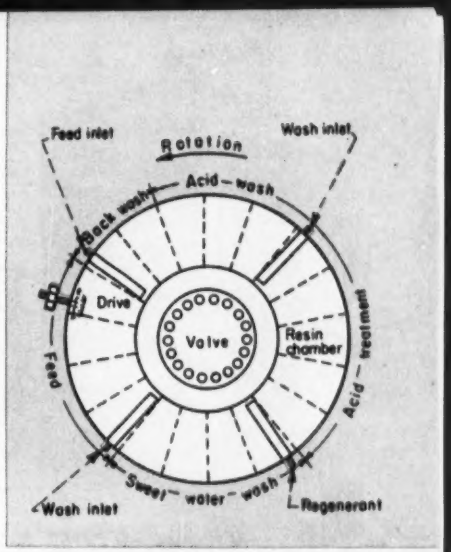


Fig. 6—Suggested design for multicompartment rotating-bed exchanger.

A freeboard or rising space of about 50 to 100% of the resin height is provided at the top of the tank to permit bed expansion without resin carryover during the backwashing step.

External piping to the column usually connects to multiport valves which control each step in the operating cycle. These can be operated manually where the cycle is long, but the trend is toward greater use of automatic control. These valves not only introduce and withdraw the proper solutions during a given step but also operate the steps in the proper sequence and for the proper period of time. The cycle can be controlled by a timing device, by volume measurement or by pH or conductivity measuring devices.

Of course, an ion exchange system is not complete without regenerant tanks, waste discharge sumps, and sometimes pumps. A complete installation for demineralizing water (see Applications) is indicated in Fig. 8.

Design

In fixed-bed operations the information we desire is the concentration of the ion of interest at the exit of the resin bed at various times. These data supply the breakthrough curve in Fig. 9. Normally, the unit is taken off stream and regenerated when the unwanted ion breaks through and rises to some maximum tolerance $(Na^+)_b$. Then the dotted portion of the curve never exists. When the tolerance level is reached, the bed is taken off stream and eluted to some desired regeneration level and the cycle repeated. The effect of this treatment is indicated by the dashed line in Fig. 9 (the wash steps having been neglected in this plot).

The factors that determine the magnitude of the breakthrough volume V_b (the amount of feed treated before shifting to the elution step), are fairly obvious. Strictly from a materials-balance viewpoint, if all ions were removed from the solution instantly, V_b would increase with a larger resin bed, a resin of higher capacity or a feed solution of lower ionic concentration $(Na^+)_o$. However, since the process takes place at a finite rate and with an equilibrium other than infinite, V_b is also increased with increased rate constant, increased equilibrium constant and decreased flowrate. Further, since the ion must pass from the fluid to the solid, or vice versa, it may be affected by mass transfer through a fluid film or an apparent solid film. If this occurs, and it normally does in ion exchange units operated industrially, the rate constant is affected by the flowrate and particle size.

The design of any unit must also take into account economic factors, two of which are resin utilization and regenerant efficiency. The former, related to operating capacity, is the ratio of the quantity of ions removed from the solution during treatment, to the total amount of ions that could have been removed if all of the ultimate exchange capacity of the resin bed had been utilized. In terms of Fig. 9, Area abhg is the quantity of

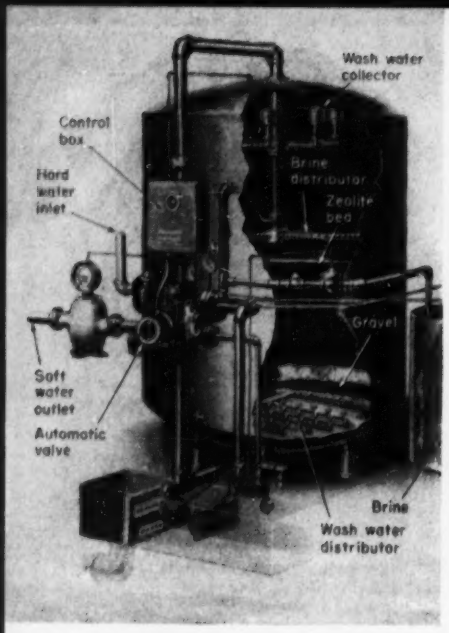


Fig. 7—Fixed-bed construction typified by zeolite water softener.

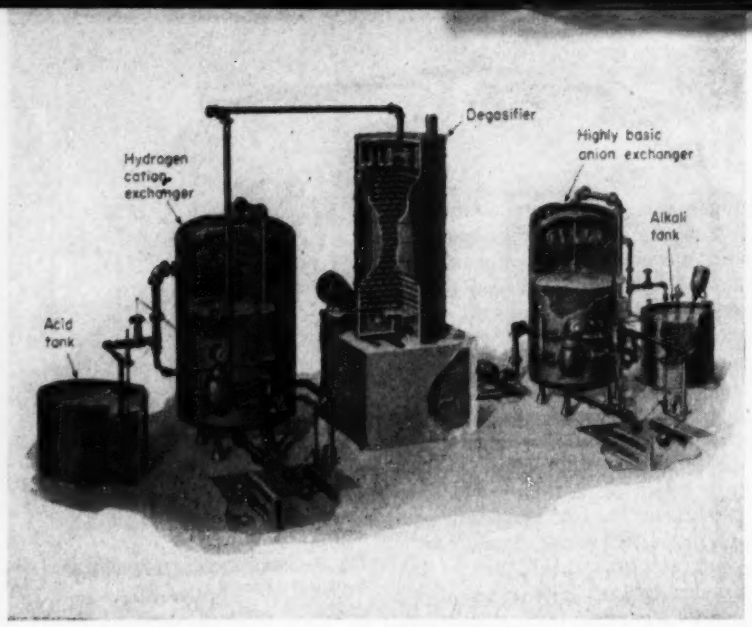


Fig. 8—Two-step demineralizer employs cation and anion beds, with degassifier, regenerant tank and controls.

ions in the volume of solution treated before breakthrough occurs, and Area *abc* is the quantity of ions leaking through the column. The difference, Area *achg*, represents the quantity of ions removed. Then: Resin utilization = Area *achg*/*A*, where *A* = (ultimate capacity of resin per unit volume) × (total resin volume). From the definition it is apparent that resin utilization is that fraction of ultimate exchange capacity that is operating capacity.

Regenerant efficiency is the quantity of ions removed from the resin as compared to the quantity of ions present in the volume of elutant used. An efficiency of 100% would mean that all of the elutant was used to regenerate the bed. Fig. 9 shows the elution graphically. Area *bcdef* represents the quantity of ions removed from the resin bed during elution. (Obviously this must be equal to the quantity of ions picked up during saturation, Area *achg*, if the column is to operate over a large number of cycles without gradual loss of removal capacity). Area *acdefb* represents the total quantity of ions originally introduced to the unit, i.e., the same as Area *abhg*. Then: Regenerant efficiency = Area *bcdef*/*B*, where *B* = (concentration of elutant) × (volume of elutant).

Although it is not immediately apparent, regenerant efficiency decreases as the resin utilization increases, so that the quantity of resin required in the bed must be balanced against the cost of elutant required to regenerate it.

Sample relations between these two factors are shown in Fig. 10 which deals with softening operations at a municipal plant, as given by Streicher and Bowers,[18] and some correlation data of Kunin and Myers.[19] Each of these curves is for a specific flowrate, resin particle size, feed concentration, and concentration of the regenerant solution. Any difference in the ion exchange system would shift the curve. Normally, a slower downflow flowrate (of either the feed or the elutant), a smaller size of resin particles, or a lower equilibrium constant, would all move the curves to the right.

Upflow of the elutant during regeneration moves the curve to the left because of the lower contact efficiency resulting from reverse flow.

The simplest method of designing an ion exchange bed is to use a plot similar to Fig. 10 (if one is available) for the applicable flowrate, resin par-

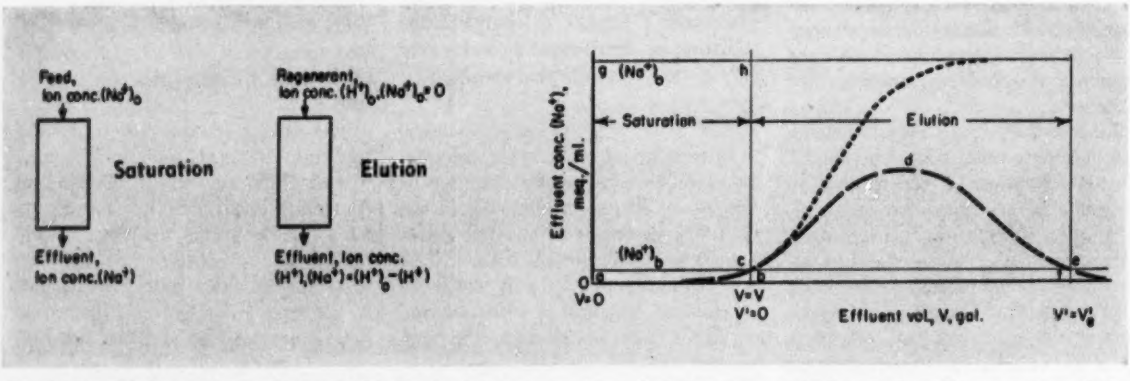


Fig. 9—Simplified operating cycle of a fixed-bed unit, showing saturating and eluting steps, at the left; at the right, saturating and eluting curves, illustrating breakthrough at Point b.

ticle size, and so on. A regeneration efficiency can be picked first, and the resin utilization taken from the plot. Then a resin volume can be chosen and the quantity of ions that can be removed calculated. Knowing the feed concentration and the leakage level of the ion to be removed, the length of the treatment step can be computed. Likewise, given the concentration of the elutant, the length of the regeneration step can be calculated from the regenerant efficiency. Another resin volume can then be chosen, and these computations repeated. Application of cost factors to this information permits determination of relative softening costs for each bed volume chosen (at a given regenerant efficiency).

As shown in Fig. 11, such calculations lead to an optimum cost value resulting from the balance of many terms such as labor, resin and regenerant costs.[17] This can all be repeated at other regenerant efficiencies, and as seen in Fig. 11, will lead to optimum values of both bed volume and regenerant efficiency for this specific flowrate and particle size.

The cross-sectional area of the bed will already have been determined by the flowrate and throughput desired (since flowrate is expressed in terms of gpm./sq. ft.) but the area should be such that the height of the bed is not so great as to cause pressure drop troubles, nor so small as to cause decreased contact efficiency because of channeling.

Actually, a different flowrate and particle size than those on which the resin utilization-regenerant efficiency plot was based may lead to a more economical design. However, operating experience with reasonable conditions —probably coupled with a desire to avoid the complication of too many variables—has led most resin producers to recommend standard operating conditions for use. In water softening these are:

Effective resin particle size	0.4–0.5 mm.
Minimum bed depth	24–30 in.
Treatment flowrate	2–5 gpm./cu. ft.
Regeneration flowrate	1–2 gpm./cu. ft.
Elutant concentration	10–20% NaCl

The biggest drawback to this empirical method of design is the necessity of having the resin utilization-regenerant efficiency plot for the proper exchange conditions. In some cases this may lead to a choice of conditions of operation selected simply because a plot is available. Such a difficulty may be avoided by using a more basic design method such as that developed by Thomas[18] and modified by others[19, 20, 21, 22, 23, 24] which relates all of the variables indicated earlier to a breakthrough curve. The relations can be expressed dimensionally in terms of an equilibrium constant function r, a number of transfer units s and a number of bed volumes t/s of feed; for the regenerant curve a number of bed volumes t'/s is also needed. As with other techniques, this method takes into account the equilibrium relation for the ion exchange, the rate at which the ion is transferred to or from the resin, and a material balance for the ion.

For trace exchange the breakthrough relation is, according to Hiester and Vermeulen:[25]

For saturation

$$\frac{Na^+}{(Na^+)_0} \leqq \tfrac{1}{2}\,[1 + H(\sqrt{s} - \sqrt{s\,(t/s)})]$$

for $t_b/s \geq t/s \geq 0$

For elution

$$\frac{Na^+}{(Na^+)_0} \leqq \tfrac{1}{2}\left[1+H\left(\sqrt{s}-\sqrt{s\left(\frac{t_b}{s}+\frac{t'}{s}\right)}\right)\right] - \tfrac{1}{2}\left[1+H\left(\sqrt{s}-\sqrt{s\left(\frac{t'}{s}\right)}\right)\right]$$

for $t'_a/s \geq t'/s \geq 0$

where H is the error function given by

$$H(z) = \frac{2}{\sqrt{\pi}}\int_0^z e^{-\alpha^2}\,d\alpha$$

Fig. 9 is an example of such a breakthrough curve for a given bed with the dimensionless terms converted to physical units. In order to convert the number of transfer units to the amount of resin required, we need the height of a transfer unit (HTU) under the conditions of operation. The same researchers[26] have supplied this information in the form of a correlation relating the HTU to mass transfer factors such as superficial flowrate, particle size, fluid diffusivity (i.e. Reynolds and Schmidt Numbers) and the diffusivity of the ion in the resin. This correlation is shown in Fig. 12, where f_z is the void fraction in the resin column, d_p is the resin particle diameter, τ_p/τ_f is the ratio of the solution and resin residence times in the unit ($= 0$ for fixed beds) and $(D_p)_{Na}/(D_f)_{Na}$ is the ratio of the ion diffusivity in the particle and fluid phases. The term H is the same trace equilibrium constant used in the batch discussion; for monovalent ions it is inversely proportional to the total ionic concentration.

At first glance it would appear that the lowest HTU is achieved in the internal diffusion resistance controlling region. However, this region is usually reached by increasing the solution flowrate and decreasing the resin particle size. But these actions result in an increase in pressure drop (and pumping costs), so that the two opposing economic factors (HTU and pressure drop) must be balanced off against each other.

This basic theory and the correlation can also be used to predict resin utilization-regenerant efficiency

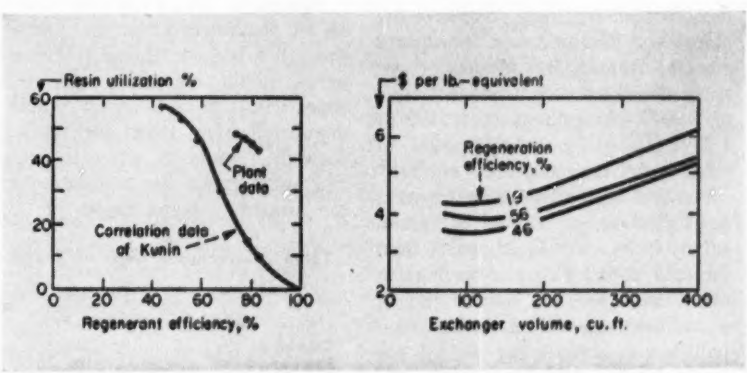


Fig. 10—Typical resin utilization-regenerant efficiency curves.

Fig. 11—Softening cost for 125 gpm. water with 50 ppm. hardness as $CaCO_3$.

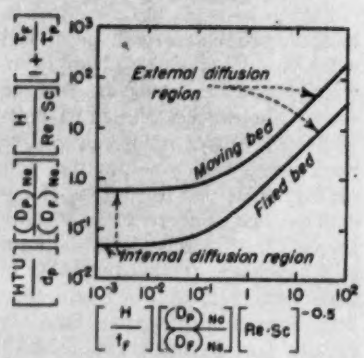


Fig. 12—Correlation of mass transfer rates.

curves for various operating conditions. The authors, with Prof. T. Vermeulen of the University of California, are now preparing such curves by this method for a forthcoming book to be published by McGraw-Hill.

Applications

Water Treatment—The applications for fixed-bed operation are numerous. As pointed out earlier, one of the major uses has been in water treatment, for (1) water softening, (2) dealkalization, and (3) demineralization. In this field there are as many process modifications as there are purification requirements, and each has its particular advantages. For example, ordinary softening can be achieved with a sodium-regenerated cation resin, but this does not reduce the total dissolved solids. Therefore, for those situations where higher quality product is necessary, such as feedwater for high-pressure boilers where scale formation must be prevented, a combination of a hot lime treatment step, followed by use of sodium-regenerated resin, is rapidly gaining favor over the older hot lime-and-soda phosphate process. Among its advantages are lower operating costs (chemical costs of 0.9¢/1,000 gal., as compared to 2.5¢/1,000 gals.), zero hardness in effluent and ease of process control.[26]

Another type of water treatment is de-alkalization, or removal of certain anions (principally bicarbonate) from the feed water. This can be done in many ways such as by the use of a hydrogen-regenerated cation resin (which also softens the water), followed by de-aeration to remove the carbon dioxide, or the use of a chloride-regenerated, strongly basic anion resin to remove the bicarbonate, or a combination of the two.

The third type of treatment is demineralization, in which the raw water is treated by both a hydrogen-form cation exchange and a hydroxyl-form anion resin. The resultant product contains no ions (the hydroxyl and hydrogen combining to make more water). One method of doing this is the two-bed system, with a degasifier, utilizing a strong cation and anion resin as shown in Fig. 8. Silica is also removed in this case.

This technique must of course always compete with evaporation, and some interesting comparisons have been made along this line. Table IV, from a paper by Applebaum and McKeown,[27] gives cost information for several such comparisons.

Demineralization of seawater is a timely example of the relative economics of evaporation and ion exchange. Evaporation involves removing the water from the ions by the use of fuel energy; ion exchange removes the ions from the water at the expense of chemical regenerants. The cost of the latter process therefore increases with increasing dissolved solids concentration, whereas the fuel efficiency of the first process increases. At seawater concentrations, the regenerant costs are excessive compared to the value of the water (minimum cost at 100% regenerant efficiency would be about $13/1,000 gal.), so that ion exchange just isn't feasible. However, as shown in Table I (and as we shall see later) the use of selective ion exchange membranes in electrodialysis does appear feasible.

Mixed-Bed Demineralizing—Passage of an electrolyte-containing solution through a bed containing a heterogeneous mixture of cation and anion resins results in more nearly complete demineralization than does passage through a series of alternate cation and anion tanks. An explanation for the superior performance of the mixed-bed lies in the irreversibility of the exchange reactions when the two resins are unified. Reactions for removal of sodium chloride in separate cation and anion beds may be represented as follows:

Cation bed

$$Na^+ + Cl^- + H \cdot R \rightleftarrows H^+ + Cl^- + Na \cdot R$$

Anion bed

$$H^+ + Cl^- + R \cdot OH \rightleftarrows R \cdot Cl + H_2O$$

and if any salt leaks through the cation bed, the effluent from the anion bed will contain caustic. In fact, some salt leakage does occur as the cation bed approaches exhaustion by virtue of the reversibility of the reaction in this bed.

In a mixed bed, on the other hand, the combined reactions can be considered as a single irreversible reaction:

Mixed bed

$$Na^+ + Cl^- + H \cdot R + R \cdot OH \rightarrow Na \cdot R + R \cdot Cl + H_2O$$

Splitting of salt and neutralization of residues occur simultaneously, and the reactions go essentially to completion.

Water treated in this manner may have an electrical resistance of 1×10^6 to 2×10^7 ohms per cc. Because it is so pure (and thus unbuffered), contamination with trace amounts of acids or bases affects the pH drastically. Even exposure to atmospheric CO_2 will depress the pH.

After exhaustion or saturation of a mixed bed unit, the resins are separated by hydraulic classification, with the lighter anion material being suspended above the cation resin and regenerated separately as shown in Fig. 13.[28] Following regeneration, the resins are mixed by compressed air introduced through the bottom, and the unit is ready for service. This sequence of operations can be carried out completely automatically.

Parenthetically, it might be noted that some of the continuous countercurrent contactors discussed later may be adaptable to the use of mixed resins. Such a system would be composed of four units: one for mixed-bed

Table IV—Relative Costs of Evaporation vs. Ion Exchange Demineralization

Raw Water	Total Dissolved Solids, Ppm.	Alkalinity, %	Fuel Cost, $/MM Btu.	Cost, $/1,000 Gal. Evaporation	Cost, $/1,000 Gal. Demineralization
Ohio River	300	19	0.20	0.98	0.93
New England well	100	48	0.39	2.84	0.81
Delaware well	50	12	....	1.81	0.44
Iowa well	150	50	0.21	1.87	0.92
Lake Michigan	156	80	....	0.46	0.12

demineralization, one for separation of the resins by elutriation, and separate ones for cation and anion regeneration and washing. The continuous system may minimize the principal economic disadvantage of present mixed-bed practice—low regeneration efficiency.

In our questionnaire sent to industrial ion exchange personnel, we asked their opinions of mixed bed exchange. Their answers were that a mixed bed unit is indicated whenever extreme effluent purity is required. Specific cases include the water required for coating phosphors on television picture tubes, for high-pressure boiler make-up, and for pharmaceuticals (in preference to distilled water). But for most demineralization applications, conventional fixed bed exchange is adequate and less expensive. There are instances where a mixed bed may be used to "polish" the effluent from a plant with separate cation and anion beds.

Metals Recovery—A second important use of fixed-bed ion exchange is in the recovery of metals from industrial wastes. In many cases this has been of two-fold importance, i.e., in the recovery of metal values and in the elimination of waste-disposal problems. For example, in anodizing aluminum with chromic acid a considerable amount of aluminum dissolves and contaminates the solution to the point where it must be disposed of, although a considerable quantity of the acid is still available. This can be avoided by removing the aluminum with a hydrogen-form cation resin, which regenerates the chromic acid at the same time.

Further, some of the acid is lost when the treated metal is rinsed. Use of a strong anion resin removes the chromate from the rinse water and prevents a serious waste disposal problem. The anion resin can then be regenerated with caustic to form sodium chromate which can then be passed through the cation exchanger to make chromic acid. Appreciable savings in chromium by this process have only recently been made possible with the development of resins resistant to this strong oxidizing agent.

The same problem occurs in chromic acid plating baths except that here the metallic contaminants are

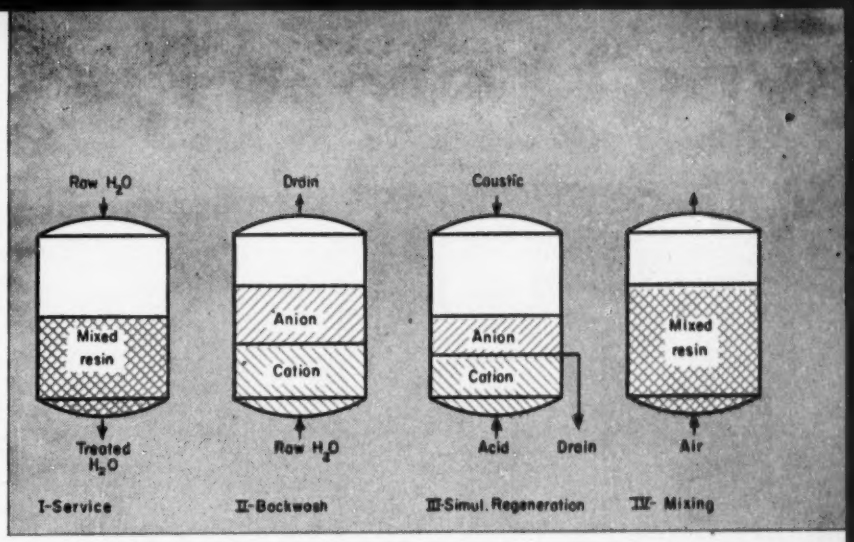


Fig. 13—Cycle of a mixed bed unit employing simultaneous acid-caustic regeneration.

iron, copper, zinc, etc. In a typical installation the recovery process nets $17 per day, compared with the former disposal costs of $63 per day.[20]

Other uses have been in the recovery of copper from cupra-ammonium rayon wastes, and in zinc recovery from a viscose rayon spin bath. Suggested uses include recovery of sodium stannate from tin plating rinse waters and recovery of copper, zinc and chromium from the dilute pickle rinse solutions encountered in the copper and brass industries. (Rinse waters have generally been studied first because greater dilution offers higher removal efficiency, thus greater justification for the initial trials.) Another use has been in the removal of iron from sulfuric acid pickle liquor.

In another application, Bickell and Trethewey[20] found that ion exchange permitted the economical utilization of sodium base sulfate liquor for pulping. In one fixed-bed column they recovered the sodium salt from a solution of the smelt (the ash resulting from burning concentrated liquor). This released H_2S, which was burned to SO_2. The sulfurous acid was used to regenerate a second bed of resin. The effluent from this column was a concentrated solution of sodium sulfite, which was recycled to the digester.

Organic Purifications—A third major use of the fixed bed has been in purification of organic materials, such as crude glycerine and formaldehyde. In a typical glycerine installation, 1.6% NaCl and 0.5% Na_2SO_4 were removed from 19.8% glycerine solution. At first glance, demineralization of a solution approaching sea water salt concentration would seem impractical economically. However, the high unit value of the finished product justifies using ion exchange in competition with the existing purification method, distillation. Ion exchange has another advantage over distillation in its ability to remove color from crude glycerine. The cost (including resin amortization, labor, and regenerant chemicals) was about 0.45¢/lb. of 95% glycerine according to Kahler and Reents.[21] Actually, distillation becomes competitive with ion exchange with an ash content of about 10% in a crude, or 2% in sweet waters. (Sweet water is produced during the hydrolysis of fats and oils to fatty acids and has a lower ionized solids content than crude glycerine.) A typical flowsheet for sweet water purification is shown on the following page in Fig. 14.

In the synthesis of methanol from carbon dioxide and hydrogen, excessive amounts of amine and ammonia are produced during starting up or shutting down of the high pressure system. These can be and have been removed by a hydrgen-form cation resin. A similar use is encountered in production of formaldehyde by catalytic oxidation of methanol, where it is difficult to prevent some further oxidation to formic acid (about 0.04% formic acid is formed). The contaminating acid can be removed with a strong anion exchanger of hydroxyl form. Cost is about 0.004¢/lb. of 40% formalin.[21] In the hydrolysis of ethylene oxide to ethylene glycol, about 0.15% sulfuric acid is used as a catalyst and must be removed. This can be done by the same technique

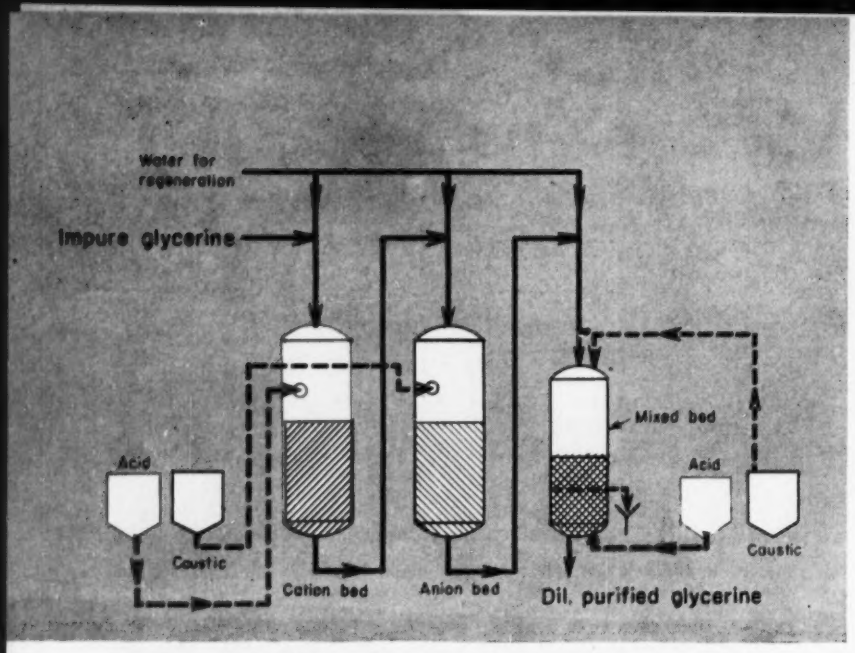


Fig. 14—Flow sheet for ion-exchange purification of glycerine sweet water.

used for formic acid but at a cost of about 0.11¢/lb. of ethylene glycol.[81]

De-ashing of sugar solutions is another important application, but it has been reported on so extensively it will be mentioned only briefly here. Corn Products Refining Co. and the Layton Sugar Co. are the principal users of this technique at the present time, although several other organizations are investigating it. Layton uses it for topping off the normal lime purification procedure to get a larger yield of higher purity sugar, from both cane and beets. Necessarily, beet molasses production is reduced, but this is only a disadvantage when molasses prices are high.

Ion Exclusion

Another technique for the removal of minerals from non-ionized organic materials, ion-exclusion, uses ion exchange resins although no intended exchange of ions takes place in the process.[82]

When a mixture of ionic and non-ionic solutes is passed downward through a bed of resin, the ionic materials tend to be excluded from the resin by virtue of the high ionic concentration within the resin. Non-ionics, on the other hand, pass into the resin much more freely, this diffusion being more or less independent of the ionic concentration. The result is a more rapid movement of the excluded ionic material through the column than of the molecular solute. Generally, only a portion of the resin bed is utilized before the feed is stopped and an elutant (usually water) is introduced. This displacement of solutes with the elutant gives rise to their separation in the effluent according to the bell-shaped concentration curves typical of the elution development of a fixed bed as chromatograms.

The design factors in ion exclusion have been analyzed by Wheaton and co-workers[83] and in general it was found that the separations are enhanced by low ionic concentrations, small feed volumes, low flow rates and high temperatures. Although a variety of resins can be used, the sulfonated styrene type is recommended, since, being strongly cationic, it effectively excludes ionic solutes.

Ion exclusion may find application in treating organics containing higher concentrations of acids, salts and alkalies than would be economical to process by the methods of conventional ion exchange.

Potential—Fixed bed ion exchange of all types will continue to be an important technique in the future, alongside of continuous ion exchange and batch exchange, because of its simplicity of construction and operation. Also, as will be seen later, it will have an economic advantage over countercurrent operations at the lower throughput rates.

Continuous Ion Exchange

Although continuous ion exchange has been studied extensively for many years, it has been commercialized only very recently. Because the continuous method offers such an important potential, process engineers should become familiar with current developments that may eventually lead to its wide-spread commercial use. This impression is strengthened by the returns from our industrial questionnaire, which placed continuous ion exchange first among the new developments in the field.

As a matter of further interest, Hutcheon[84] recently presented an excellent review of continuous ion exchange at the Society of Chemical Industry's Conference on Ion Exchange held in London in April 1954. The reader is referred to this for additional information.

Continuous ion exchange implies the continuous, countercurrent flow of the resin and solution through some contacting device as indicated schematically in Fig. 15. This process offers a means of utilizing regenerant chemicals more effectively. Also it uses less resin and rinse water and its equipment is more compact than that of either batch or fixed bed methods. Since saturation and regeneration are necessarily carried out in separate sections, each section can be designed specifically for the most efficient operation. In fixed-bed ion exchange, the geometry of the resin bed must be a compromise between the ideal for saturation and that for regeneration.

Equipment

In spite of the obvious advantages of a continuous contactor, only one commercial ion exchange unit (Dorr's Hydro-Softener) is truly continuous and countercurrent in operation (Fig. 16).

In the Hydro-Softener, water softening is accomplished essentially by fluidized contact between water and two separated beds of resin in the larger of two tanks. Exhausted resin is transferred from the softening cell to a regeneration cell by means of ejectors. Since concentrated brine has a lower volumetric flowrate, the regeneration unit can have a smaller diameter, illustrating the advantage of having separate functional sections. The descending resin is washed free

of salt before it is recycled to the softening cell.

A pilot plant unit, used to soften the water of Baxter Springs, Kas., consists of a 6-ft. diam. softening cell and a regeneration cell only 22 in. in diameter. Using 84 cu. ft. of Nalcite HCR resin, this unit was operated in one test at 170 gpm. to reduce the hardness from 160 to 4 ppm. $CaCO_3$ at a salt efficiency of 50%. Only 10% of the ultimate capacity of the resin was used per pass.

Units are available for treating up to 800 gpm. Initial costs are reported to be lower than for equivalent fixed bed plants, mainly because of smaller equipment and lower resin requirements. Reduced brine and rinse water consumption contribute toward lower operating costs. Attrition of resin is expected to be less than 10% per year.

This technique has not been commercialized more extensively because of the inherent mechanical and hydraulic difficulties in obtaining satisfactory contact between a counterflowing liquid and subdivided solid. Problems include those associated with the small density difference between resin and solution, attrition of moving resin, separation of the two phases after contact, and channeling and distribution of the two phases through the contactor. Solution flowrate is limited by carryover of resin from the top of the contactor (flooding). The recommended maximum flow rate is 7 gpm./sq. ft. when softening water in a fluidized bed of nuclear sulfonic type resin having a true density of about 80 lb./cu.ft. when wet.

Contact in a fluidized bed is permissible only where there is an extremely favorable equilibrium (of which the Ca^{++} -Na^{+} exchange is a good example). Only by plug flow of the resin can a sufficient number of transfer units be attained for more difficult applications; here the solution flow rate must be held below 3.5-4.0 gpm./sq.ft. to avoid fluidization. The limiting flow rate would be somewhat less in anion exchange, where resins with a density of about 70 lb./cu.ft. are employed.

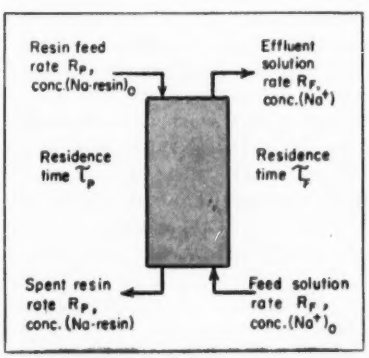


Fig. 15—Schematic diagram for simple countercurrent ion exchange operations.

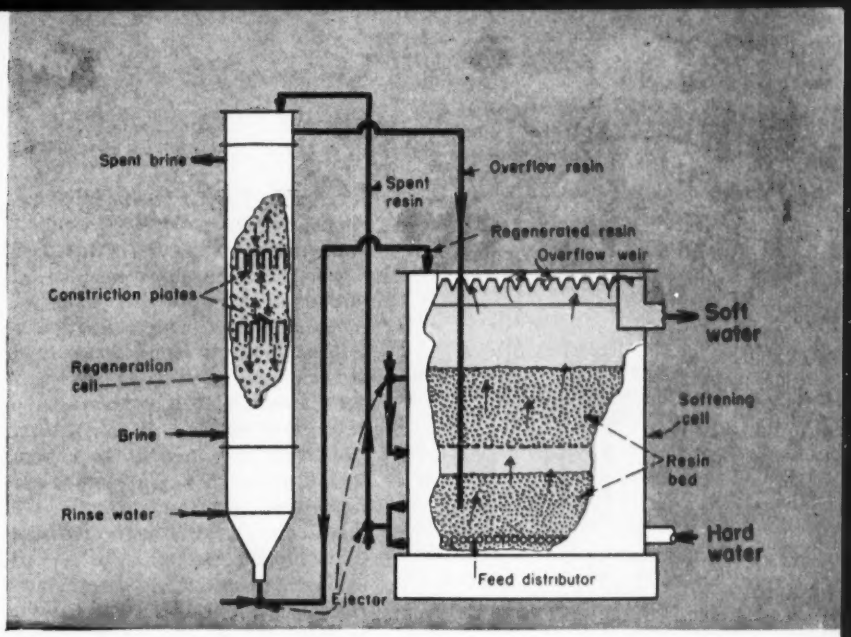


Fig. 16—Dorrco Hydro-Softener for water uses resin in two fluidized beds.

The obvious solutions to this density difference problem are: (1) Operate with solution downflow, (2) convey the resin through the contactor by mechanical means, and (3) prepare denser resins.

The contactor developed by Higgins and coworkers[86] at Oak Ridge National Laboratories (Fig. 17) is the only column-type device which utilizes solution downflow. Movement of the resin upward through the column is accomplished by application of hydraulic impulses to the base of the resin bed. In operation, the resin and solution alternately flow countercurrently through the column. During the short period of several seconds in which the resin is forced an incremental distance up the column, the solution flow must be interrupted. Then the solution is passed downward through the stationary resin bed for a predetermined interval of several minutes. Cycles are so short that the device is essentially continuous. Satisfactory separations of similar cations (sodium and lithium) have been carried out in this apparatus.

If this method of operation can be used in large diameter columns, the Higgins contactor may show the way to a commercial unit with fewer limitations than solution upflow types.

Another method for achieving resin upflow has been proposed by Weiss.[88]

Several methods for the mechanical conveyance of the resin countercurrent to the solution have been attempted. A screw may seem an obvious solution, but in practice it causes excessive attrition of the resin and short-circuiting of the two phases past each other. Actually, any of the solid-liquid contacting devices used for countercurrent extraction of oilseeds, adsorption of liquids or leaching of ores are potential contactors for ion exchange, although none has been used commercially.

McCormack and Howard[87] enclosed cation resin in a permeable casing and conveyed it like a continuous string of sausages through a counterflowing solution. Selke and Muendel[89] carried out continuous ion exchange in a similar manner by the use of an endless belt of phosphorylated cotton, using a process developed by Guthrie.[90] Mihara and Terasaki[91] circulated an endless wire mesh coated with ion exchange resin through adjacent saturant and regenerant tanks.

The third means of solving the density difference problem, namely, preparation of denser resins, is not only technically difficult, but would almost certainly reduce the rate of diffusion of ions through the resin.

Starting with the devices Nordell

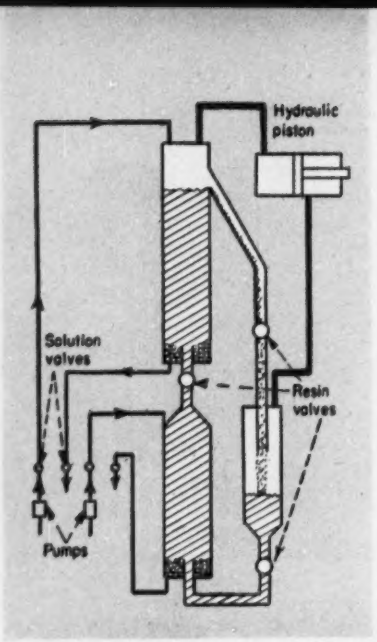
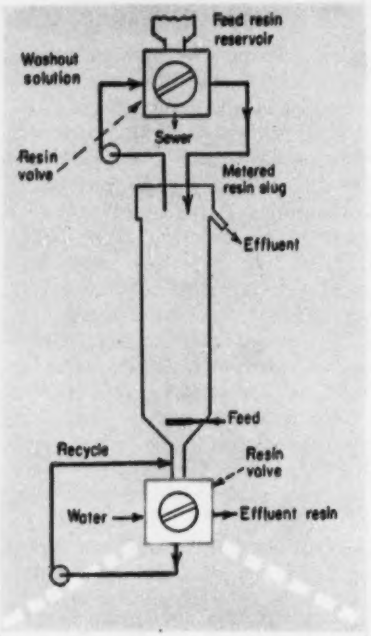


Fig. 17—Diagram of pulsed-bed continuous ion-exchange column.



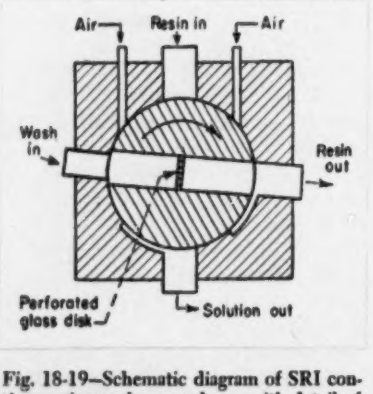


Fig. 18-19—Schematic diagram of SRI continuous ion-exchange column with detail of resin metering and dewatering valve.

patented in 1926,[40a] most continuous ion exchange contactors have involved solution upflow. Stanton[41] was the first to use a rotating plug-type valve for transfer of incremental amounts of resin from his experimental column. Contact between solution and resin occurred in a compact bed having a net downward movement by virtue of continuous addition at the top and withdrawal of resin from the bottom from the column. Both saturation and regeneration were carried out in the single column. Sieve plates improved contact in the regeneration zone. This equipment made successful separations of copper and zinc in spite of the problems of conducting multiple operations in a single contactor.

Selke and Bliss[42] developed a feasible laboratory system for continuous copper recovery from dilute solutions, transferring hydrogen-form resin into the exchange column by a rotating disk feeder. Velocity of the rising solution was maintained high enough to fluidize the entering resin. Countercurrent operation was obtained by virtue of the greatly increased density of the resin as it was converted to the copper form, which hydraulically classified the resin in the fluidized bed for discharge from the bottom of the column. By extrapolation of their experimental results, it appears that a continuous system containing 1,500 lb. of resin would be equivalent to a fixed bed system with two 5,000-lb. beds for the concentration of 1,000,000 gpd. of 0.1 N copper sulfate.

At Stanford Research Institute[43] continuous countercurrent ion exchange has been carried out successfully in a glass column nearly 4 in. in diameter. This unit will be described in some detail because it has unique features. Two rotating valves provide for dewatering and metering the resin to and from the column. The column assembly is indicated schematically in Fig. 18. The motorized resin valve, adapted from one used by Stanton[41], is shown in Fig. 19. A similar column and valve has recently been patented by McIlhenny and McConnell.[40a]

Most of the experimental work carried out with this apparatus involved transfer between alkali metals in the rising solution and hydrogen ions on the descending resin. Contact between the two phases occurs in a dense bed of resin, moving as a piston through the column. The upper valve continually supplies resin to the top of the moving bed while the lower valve withdraws it at the same rate, maintaining a constant bed height.

Resin entering the rotating valve is retained on the perforated glass disk at the midpoint of the bore. Free solution drains through this disk. As the bore passes under the right air inlet, air pressure applied by means of a cam-actuated solenoid valve dewaters the resin by forcing the interstitial solution through the disk. When the bore becomes aligned with the outlet, wash solution displaces the resin and carries it out as a slurry. Any residual wash solution is forced from the bore by air pressure.

Another development at SRI is a column insert or tapped screen assembly. This is a group of tiered screens, with openings slightly larger than the largest resin particle. A central rod passing through these screens is tapped to vibrate their centers, causing reorientation of the resin particles and thus reducing channeling. At solution flow rates below those which cause expansion of the resin bed (0.6 gpm./sq.ft.), this device promotes contact efficiency between phases, probably much as the pulse column improves the efficiency of liquid-liquid contact in extraction. When solution velocities were high enough to maintain the resin in an expanded but still not fluidized condition (up to 3.5 gpm./sq.ft.), the contact was equally good, with or without the tapped screen insert.

A correlation of the experimental data according to mass transfer fundamentals (see Fig. 12) showed that the column was less efficient (higher HTU's) than a fixed bed column operating under the same conditions. In spite of this inherent inefficiency, it has been demonstrated that resin (and equipment) requirements for a continuous countercurrent column of this type are much less than for an equivalent fixed bed unit. Selke came to the same conclusion in analyzing the performance of his continuous column.

G. Dickel[44] of the University of Munich, has studied countercurrent ion exchange over a number of years.

His contributions have been largely theoretical, but he has verified his design theories by means of some experiments with the separation of neodymium and praesodymium in small-diameter columns.

Use of ore-dressing jigs for continuous ion exchange has been evaluated by McNeil, Swinton and Weiss.[48] They used the multi-deck diaphragm jig shown in Fig. 20 for contacting sodium-form resin with a calcium chloride brine. The pulsations of the diaphragm induce alternate expansions and contractions of the resin bed on each screen. Resin, converted substantially to the calcium form in its traverse down through the jig, is carried from the bottom by an ejector to a rotary vacuum filter. Dewatered resin falls into a regenerating unit, which is a swinging sieve jig, for restoration to the sodium form by countercurrent contact with sodium chloride solution. The equipment has large capacity and is commercially available from mine equipment manufacturers. These researchers observed that the contact efficiency is only one-quarter of that reported by Selke, but the low efficiency is balanced, they feel, by the ruggedness, flexibility and ease of maintenance of the equipment.

One advantage of the swinging sieve jig used by Weiss is that the flow of resin is horizontal so that very little elevation of the resin is needed between units. Resin leaving the jig is dewatered on a second rotary vacuum filter before return to the saturating jig. Another advantage of the method is that the resin is in a semi-fluidized state on the sieve and hence anion resins could be regenerated with lime slurries. Similarly, various leach pulps might be treated directly without filtration.

Design

It is not difficult to optimize the individual factors involved in design of continuous ion exchange equipment. But it is quite another matter to compromise the conflicting choices which have to be made. For instance, while it would be desirable to use high solution velocities in the contactor (to minimize cross-sectional area and reduce fluid film resistance to ion transfer), the linear solution flowrate is limited by carry-over of resin in the solution upflow type of device and by excessive pressure drop in the downflow type. The limit is about 7 gpm/sq.ft. in each case. If fluidization is not permissible, the maximum solution rate for the upflow type is 3-4 gpm./sq.ft.

There also is probably some lower limit of solution velocity for each case, below which the increased channeling and longer HTU (due to high fluid film resistance) would preclude satisfactory operation.

As in fixed bed exchange, there is no way of controlling internal diffusion resistance (except by changing particle size), so the objective is to minimize external film resistance and thus achieve the lowest HTU's. In general, the solution velocity should be as high as permitted by hydraulic limitations. This velocity and the anticipated volumetric feed rate set the diameter of the contactor.

Other design factors of variable importance, depending upon the contacting equipment, include the following, all to be minimized:

• **Channeling**, or nonuniform flow distribution, of either solution or resin phase. The pulsating flow in jigs and the oscillations produced by the SRI tapped screen tend to give uniform flow. The resin distribution problem is most acute where the cross-sectional area changes.

• **Attrition of resin.** In fixed bed practice, resin loss due to physical attrition is almost negligible (1 or 2% per year). Where recirculation of resin through a contactor is involved, attrition can be much higher and must be considered in design. Although most of the synthetic resins have some elasticity, they are subject to mechanical destruction. Being homogeneous, the particles are not affected by fracture as far as capacity is concerned, but the fragments may plug the bed or be carried out in the effluent.

Passage of a dense or a fluidized bed of resin through a single contactor does not in itself result in appreciable physical degradation. It is primarily transfer of resin between contactors that leads to attrition. Whether resin is transferred as a slurry (by ejector, air lift or direct pumping) or as a drained mass (by screw or traveling screen), attempts must be made to minimize transfer velocities, sudden changes in direction, or mechanical abuse of the resin. In the SRI column, some measurable attrition occurred even in the tapped screen assembly, although the major source of attrition (usually 0.1% per pass) was the resin transfer valves. It is fortunate for the future of continuous ion exchange that the cost of resin replacement, even with high attrition rates, is a small item in annual operating costs.

• **Contamination** between functional sections and **dilution** with wash or transfer water. Contamination or dilution can result from ineffective dewatering of the resin between sections. Weiss' use of a rotary vacuum filter between stages and the SRI

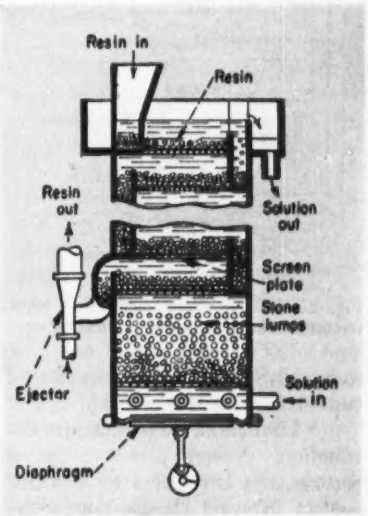
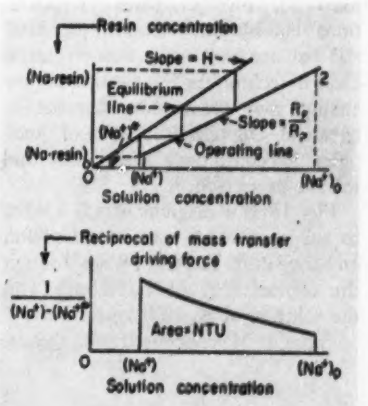


Fig. 20—Multideck jig as used by Weiss for continuous ion exchange.

Fig. 21—McCabe-Thiele diagram for trace countercurrent ion exchange, showing method of determining NTU.



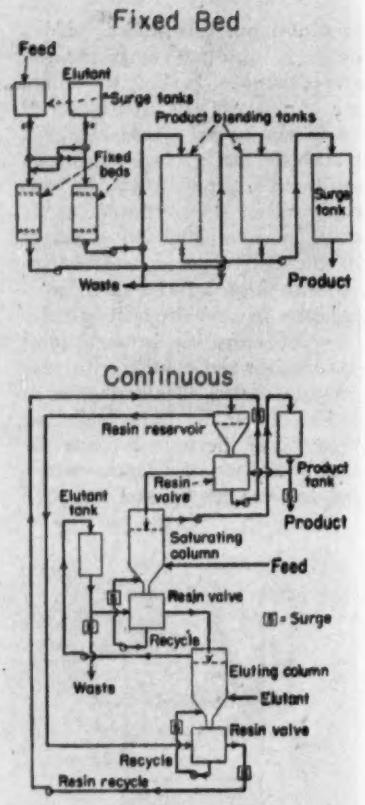


Fig. 22—Fixed-bed and continuous countercurrent units for same application.

resin valve are typical examples of current work on this problem.

• **Limitations on particle size distribution.** A very narrow range of particle sizes is required for fluidized contact to avoid classification. Solution upflow through a dense bed imposes less stringent requirements, and in solution downflow pressure drop dictates the useful particle size range.

Design of continuous ion exchange equipment, like that for batch and fixed-bed, involves three considerations: equilibrium relationships, material balance and mass transfer rates. Design techniques for continuous exchange may seem more familiar to chemical engineers because of analogies to continuous distillation and solvent extraction.

Fig. 15 is a diagram which applies to any continuous countercurrent ion exchange unit. The resin flows through the contactor at R_r cu.ft./min. and the solution at R_s cu.ft./min. ($= 7.5 \times$ gpm.) at concentrations shown.

Equilibrium relationships in continuous exchange are identical with those for batch exchange. Under trace conditions, a plot of (Na·Resin) vs (Na^+) results in the straight equilibrium line through the origin indicated in Fig. 21. Under gross conditions, the equilibrium line on this type of plot is curved.

Material balance relationships are expressed most conveniently by an operating line, as is shown in Fig. 21. This line connects the two points which define the terminal concentration conditions, Point 1 being equivalent to the top of the contactor and Point 2 to the bottom (in Fig. 15).

Fig. 21 shows how the equilibrium contacts are stepped off between the equilibrium and operating lines in the conventional manner. The more elegant number of transfer units (NTU) may be derived graphically by plotting the reciprocal of the horizontal distances between the operating and equilibrium lines, against the solution concentrations as shown at the bottom of Fig. 21. The area between influent and effluent concentrations gives the number of transfer units (based on the fluid film) directly, while the number of equilibrium contacts and transfer units may be calculated directly from the following equations:

Number of transfer units:

$$\mathrm{NTU} = \frac{E}{1-E} \ln \frac{E(1-\gamma)}{E-\gamma}$$

Number of theoretical plates:

$$\mathrm{NTP} = \frac{\ln\left[\dfrac{E-\gamma}{E(1-\gamma)}\right]}{\ln E}$$

where E = (slope of equilibrium line)/(slope of operating line) = HR_r/R_s.

Also, $\gamma = [(Na^+)_0 - (Na^+)]/[(Na^+)_0 - (\mathrm{Na{\cdot}Resin})_0/H]$, i.e., it equals the degree of approach to equilibrium transfer for the ion in the solution.

Completion of the design requires some knowledge of the height of a transfer unit (or equilibrium contact) to determine the height of the resin bed in the contactor. The correlation equation for fixed-bed mass transfer has been modified to apply to continuous countercurrent contact as shown in Fig. 12. This plot relates the height of a transfer unit HTU, with the operating variables and the characteristics of the ion-resin system. Precise application of this relation does require quite complete data on the system, such as ionic diffusivities, but even with estimates of such factors it provides a fundamentally sounder method than the empirical methods previously employed for continuous column design.

Knowing the number of transfer units required for a given exchange, and the height of a transfer unit under these conditions, one can obtain the total required height of contact zone.

Applications

After an extensive study of the economics of fixed-bed and continuous ion exchange the authors and R. K. Cohen[48] concluded that the continuous method will be the more economical means for ion removal in large scale applications—if some of the minor mechanical and hydraulic problems are solved more satisfactorily. The factors accounting for this conclusion were listed earlier.

For this study,[48] the removal of 96% of the potassium in a feed solution was specified. Fig. 22 shows the flowsheets of the comparable fixed-bed and continuous moving bed processes. The drawings are not to scale; the continuous equipment would be much smaller relatively than that for the fixed bed. It was necessary to provide the fixed-bed process (at top) with tanks to smooth out the variable composition and flowrate of the product

Table V—Comparative Costs of Fixed- and Moving-Bed Processes (Based on 4% leakage)

	Fixed-Bed Process			Moving-Bed Process		
	0.05N K^+	0.05N K^+	0.05N K^+	0.05N K^+	0.05N K^+	0.05N K^+
Feed composition	1.0N HNO_3	1.0N HNO_3		1.0N HNO_3	1.0N HNO_3	
Flowrate, feed and product	5 gpm.	175 gpm.	175 gpm.	5 gpm.	175 gpm.	175 gpm.
Annual regenerant costs	$22,600	$558,000	$150,000	$15,700	$376,000	$47,000
Total annual costs	68,500	760,000	214,000	57,150	509,000	108,000
Cost per 1,000 gal.	$31.70	$10.00	$2.83	$26.50	$6.70	$1.42

so as to put this system on an equal basis with the continuous (bottom) as regards product uniformity in composition and flowrate.

Relative costs of the two systems under optimum operating conditions for each case studied are given in Table V. The economic advantage of the continuous process is most apparent at the higher throughput when the ion of interest is the predominant electrolyte in the feed; this is the usual case in most industrial ion removal applications.

In effect, this means that large-scale ion removal processes (water softening and demineralization, metal recovery, de-ashing of glycerine, sugar syrups and other organics) are all potential applications for continuous processing. The Dorr unit has been used to date only for water softening, but the continuous technique is almost certain to supplant fixed bed methods for some of the above-mentioned processes.

Ion Separation

Ion separation is not properly a part of this report on ion exchange, but is related to it and so should be mentioned in passing. Because different quantities of various ions will be picked up from a solution by an exchange resin, this selectivity can be used as a basis of separation. However, replies to our questionnaire placed ion separation well down the list in degree of importance in both present and future applications. Furthermore, Hutcheon[34] and others believe that rapid advances in solvent extraction methods for separating inorganic ions may soon limit the use of ion separation for this purpose. So far, the only major applications of ion separation have been in the production of macro quantities of pure rare earths,[47] with some work on the separation of amino acids.[48]

Any of the three methods, batch, fixed-bed or continuous countercurrent, can be used for ion separation. The fixed bed is preferred where high purities and recoveries are needed; in the case of a continuous unit the present authors are convinced that a simple two-section unit having a saturating section and an eluting section[48] is better than a more complex unit involving reflux sections, unless the separation factor can be changed in one of these sections by the use of complexing agents.

[It should be mentioned that fixed-bed ion separation is commonly called chromatography, but that selective adsorption chromatography with adsorbents which are not ion exchangers is more widely used; it is in fact one of the methods that has been used commercially in producing chlorophyll and streptomycin, and in separating aromatics.—Ed.]

Electromembrane Ion Exchange

Until recently electrodialysis was of interest only to physical chemists and biologists in their investigations of electrochemical phenomena and the behavior of plant and animal membranes. Although the industrial significance of the process had been realized for some time, economically suitable membranes were not available. This situation has been changed considerably by the development of effective membranes from ion exchange materials.

Equipment

A perfect membrane should be selectively permeable to cations or anions alone, should have a low electrical resistance (high conductivity) and good physical strength. Ion exchange resins, prepared in membrane form, fulfill these requirements to a high degree. For instance, a cation exchange resin offers an insoluble network containing attached acidic groups surrounded by water-filled interstices. These reactive chemical groups, being free to ionize, can exchange the cations that are present in the water.

Since these random interstitial passages are small, this can only occur by displacement of cations already present. Anions cannot be exchanged by the acidic groups, so the resin is readily permeable to cations but offers great resistance to the passage of anions. In a similar manner, the basic groups lining the interstices of an anion exchange resin exchange only anions, and the resin is therefore permeable to anions but offers resistance to the passage of cations. Further, the conductance of the resins is quite favorable because of the mobility of the exchanging ions.

As far as is known, the only ionic membranes commercially available are Nepton CR-51 (Ionics, Inc.), a cation permeable membrane prepared in the form of supported sheets of a thickness of several tenths of a millimeter; Amberplex C-1 (Rohm & Haas Co.), a cation permeable membrane in the form of flexible brown sheets about 0.6 mm. thick; Amberplex A-1 (Rohm & Haas Co.), an anion permeable membrane prepared as flexible yellow sheets also 0.6 mm. thick; and possibly Nepton ARX-44 (Ionics, Inc.), an experimental version of an anion permeable membrane in the form of sheets backed by felt of 1 mm. total thickness.

In use, exchange membranes divide an electrolytic cell into two, three or more compartments and act as barriers to control ionic movement. For example, if the anode compartment of a cell is separated from the cathode compartment by a cation-permeable membrane, cations in the anode compartment can move through the membrane into the cathode portion without anions passing in the opposite direction. This case, where all the current is carried by the cations (for a completely selective membrane), is shown in Fig. 23 (top). Conversely, use of an anion-permeable membrane would permit transfer of anions between compartments without passage of cations.

The three compartment cell involves both cation- and anion-permeable membranes as shown in Fig. 23 (bottom). Here, cations can move from the middle compartment into the cathode compartment and anions from the middle into the anion section, the net result being demineralization of the central compartment. Multicompartment cells formed by alternating cation and anion permeable membranes, with a cation sheet adjacent to the cathode and an anion membrane next to the anode, can be operated in the same manner. In addition, the compartments of a cell can be connected for series or parallel flow with the obvious benefits which accrue to continuous operation.

Equipment for commercial scale

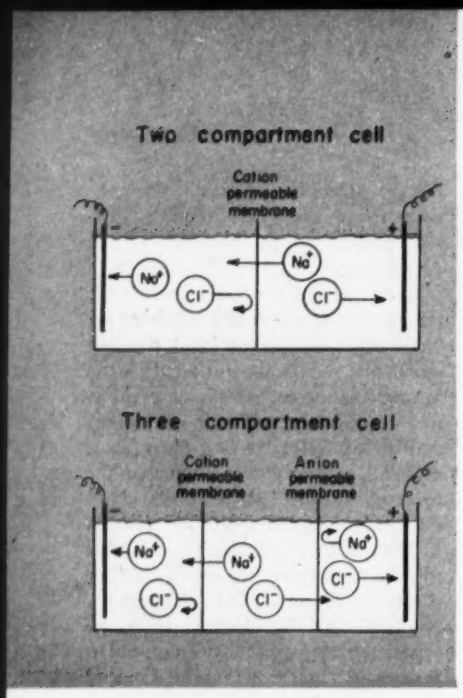


Fig. 23—Principle of two- and three-compartment electrodialysis cells.

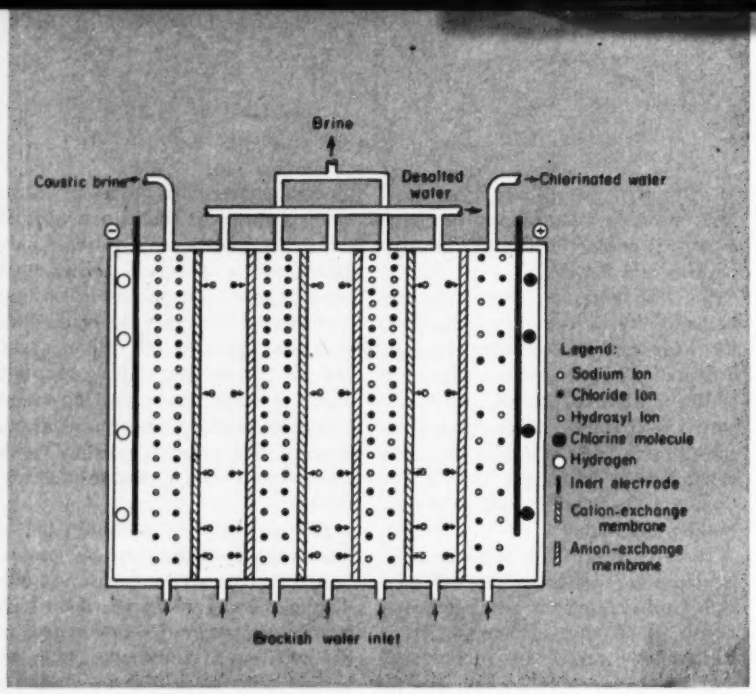


Fig. 24—Diagram showing operating principle of multicompartment electrodialysis cell; note purified water from alternate cells.

operation of the membrane cells has not yet been described, although several pilot plant and laboratory units have been announced. The Council for Applied Scientific Research in the Netherlands[49] has constructed an electrodialysis apparatus very similar to a filter press. It has 51 compartments with flow connections arranged in parallel, somewhat as indicated in Fig. 24 (from the excellent review article by Spiegler[49]). The membranes are separated by 0.6-0.8 mm. and the unit is planned for the desalting of brackish water.

Ionics Inc.[51] has operated an experimental model of a demineralizer (Fig. 25), capable of treating brackish waters at 100 gph., for the Bureau of Reclamation on its saline water conversion program. Details of construction are not given. Rohm & Haas Co.[51] has worked with a filter press model, somewhat similar to that of the Netherlands group, as shown in Fig. 26.

Design

For static cells, the most important design factors are the selectivity and specific conductivity of the membranes. The latter will affect the ohmic losses of the unit as heat and the former the (current) efficiency of its operation. In general, however, cell design follows normal electrochemical procedures. The types of factors concerned can be shown by considering a unit for the demineralization of a saline water.

First, a certain amount of energy is required for the electrolytic reactions, in this case the formation of chlorine or oxygen and hydrogen, plus the overvoltage (for a possible total of 3 volts). Next, a certain membrane potential must be supplied, due to the differences in concentrations of the solutions on opposite sides of the sheet. Obviously, then, the total voltage per compartment, and thus the current, decreases as more membranes are added. Thus a large number of membranes is a definite design necessity. Diffusion of electrolytes—due to imperfect selectivity or leakage—and electro-osmotic water transport play an important role in the power economy. The former reduces efficiency because ions are transported into the demineralized water, the latter because the pure water travels into the brine compartments. Both effects decrease with increasing cross-linking of the membrane material, but the resulting higher resistivity requires a compromise in the extent of this change. For those systems involving flow of the solutions, account must be taken of electrode kinetic effects, diffusion rates of the ions through the resin membranes and across the fluid films at the membrane faces.

The most obvious application of the ion exchange type of permeable membranes is in the demineralization of saline water. In this case, a multicompartment cell with alternating cation and anion membranes is used, with brackish water passing through the compartments in parallel as shown in Fig. 24. The salts will be removed from alternate compartments and transferred to adjacent compartments from which they cannot migrate electrically, but will be removed by the solution flow. Hence the streams from the alternate compartments will consist respectively of water of a reduced mineral content, and of enriched brine.

The use of multicompartment cells for this purpose has one other advantage besides current reduction: the cost of equipment per compartment, i.e., the expenses for electrodes, frames, and so on, will be much lower. Estimates have been given for the cost of de-salting water by this means and the figures show remarkable agreement when throughput is taken into account, as is shown in Fig. 27. The information is taken from the Second Annual Report of the Bureau of Reclamation on Saline Water Conversion,[51] the Bureau's Research and Development Report No. 1[52], also the Organization for European Economic Cooperation report on demineralization of salt water,[53] and the book by

Ellis,[54] "Fresh Water From the Ocean." These estimates cover a throughput of 1.7 to 700,000 gpm. The data are not exactly comparable, but the effect of the different bases is relatively minor in most cases.

The data from Refs. 51 and 52 are worth considering in more detail, since they show the effect of salt concentration on various design and cost factors. Thus in Table VI the information for sea water (35,000 ppm. salinity) was extrapolated by the present authors from these data.

It is realized that there are difficulties in estimating these figures from the results of the operation of a 100-gph. unit—a scale-up of 32,600. Ionics Inc. will do further work to field test the unit for the Bureau of Reclamation. The field unit will be of sufficient size to establish the effects of field conditions on the process and to provide firmer estimates of water production costs. One important fact that should be learned from these tests is the strength and stability of the membranes over a considerable period of time.

Ionics has an experimental 15 gph. demineralizer for reducing 31,000 ppm. harbor water to a potable level (200 ppm.) at Woods Hole Oceanographic Institute in Massachusetts. It is in continuous, unattended operation 24 hr. a day, 7 days a week, and is equipped with automatic devices to shut down in case of failure.

Applications

The region in which electrodialysis should be used for demineralizing solutions, after it has been proved out, is not clearly defined. However, at low salt contents the resistance of the solution increases and at some value (300 ppm. has been suggested) it will no longer be economical. The upper limit has been suggested as the salt concentration of the sea water itself.

Many other uses for electromembranes have been suggested, including desalting of aqueous organic solutions and recovery of sulfuric acid and iron from spent sulfuric acid pickle liquor.[55] They also appear applicable to production of salt-free caustic and chlorine by electrolysis of sodium chloride; recovery of chlorine or hydrochloric acid from spent hydrochloric acid pickle liquor; splitting of waste neutral salts such as sodium sulfate; preparation of sebacic acid from mono-sodium sebacate and subsequent purification of the acid; preparation of amines from their hydrochloride salts and their subsequent purification; concentration of dilute salt solutions; electrolytic processes where the cathode and anode products must be kept separated; and so on. However, none of these uses is yet in operation on a commercial scale.[56] Actually, it appears that electromembrane ion exchange has great potentialities, but so far no one has been able to realize them.

Table VI—Electrodialysis Demineralization of Saline Waters to 350 ppm. (Based on treatment of 54,300 gpm. or 10 acre-ft./hr.)

Salinity, ppm.	885	4,635	10,000	35,000
Energy required, kw.	8,500	34,500	75,300	225,000
Power required, kwh./1,000 gal.	2.6	10.6	23.1	68.0
Membrane area, sq. ft.	330,000	3,300,000	6,600,000	23,500,000
Membrane and spacer costs, $	440,000	4,400,000	8,850,000	31,500,000
Investment cost, $	1,650,000	10,420,000	20,780,000	51,000,000
Operating cost, $/1,000 gal.	0.01	0.06	0.12	0.42
Operating cost $/acre-ft.	4.10	19.50	40.10	135.00

Ion Exchange Future

Although the early optimism for ion exchange as a cure-all has been tempered by experience, this unit operation will continue to find an increasingly important place in the process industries. A better understanding of design fundamentals, and new equipment and materials developments, will hasten the growth of this unit operation.

Fixed-bed methods are now used almost exclusively. They will continue to be employed for low throughputs, for ion separation work and also when operating simplicity and low maintenance are the most important factors. Batch techniques have perhaps not been used to as great an extent as justified when a favorable equilibrium exists, or when a slurry is to be processed. However, these same conditions may also indicate continuous ion exchange in a semi-fluidized bed. The potential offered by continuous countercurrent methods should soon be realized, especially for ion removal applications involving high throughputs. Availability of ion-selective membranes will reduce the

Fig. 25—Three-unit experimental brackish-water demineralizer developed by Ionics, Inc., using Nepton membranes.

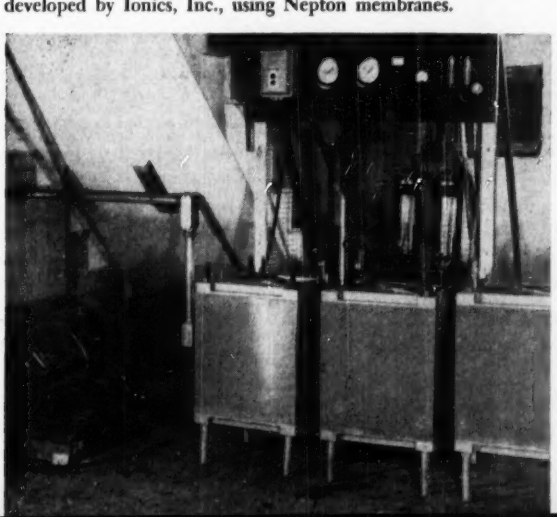


Fig. 26—Experimental membrane dialyzer developed by Rohm & Haas Co., with 101 membranes of Amberplex A-1 and C-1.



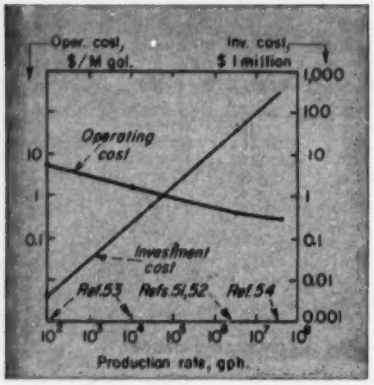


Fig. 27—Operating and investment costs for seawater electrodialysis.

cost of electrodialysis, so that it may well become the method of choice in treating solutions more concentrated than would be economical to process by ion exchange.

Replies to our questionnaire indicate that water treating (softening, demineralizing, removing silica and reducing alkalinity, in that order) is now and will continue to be the largest single area of application. Metal recovery, however, is expected to move up from sixth to third place, right after demineralization of water. Deashing organics, separating ions, recovering acids and bases and catalysis follow well down the list.

In conclusion, the authors wish to acknowledge the cooperation of many individuals and organizations in the preparation of this report, in particular, the assistance of I. M. Abrams, Chemical Process Co., and J. L. Jacobs, Jacobs Engineering Co., who read the manuscript and gave helpful criticisms.

Acknowledgment is also due to the numerous companies who replied to the questionnaire and graciously supplied informative comments and industrial literature. These organizations are listed in Tables II and III.

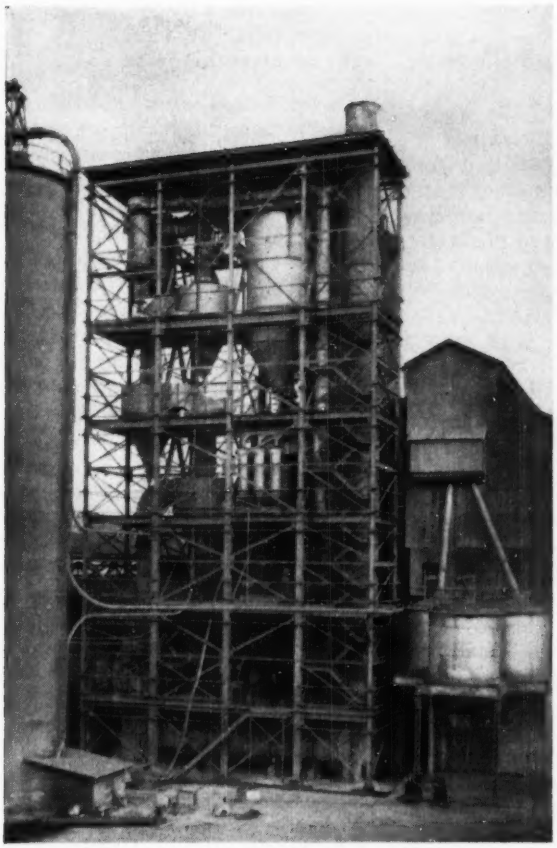
We likewise are grateful to the many people engaged in ion exchange research who responded to our inquiries regarding new developments in the field.

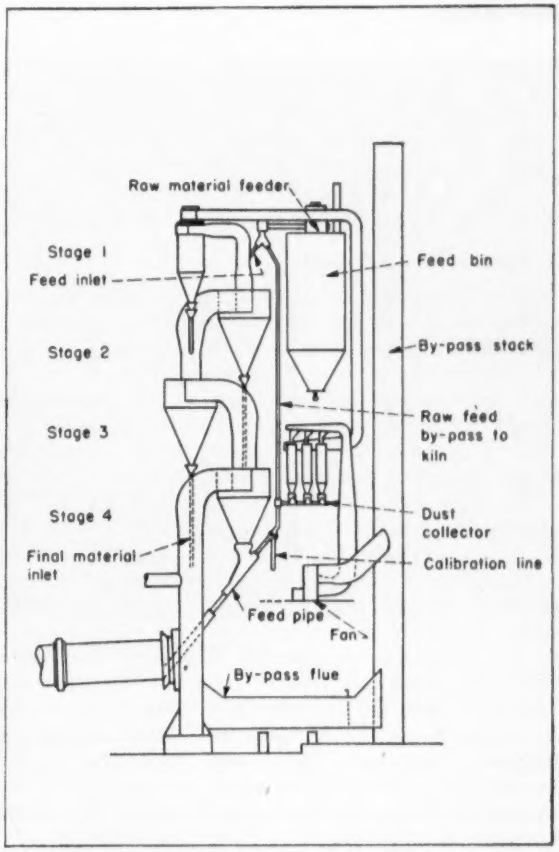
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References

1. Adams, B. A., and Holmes, E. L., *J. Soc. Chem. Ind.*, **54**, 1-6 T (1935).
2. Boyd, G. E., Schubert, J., and Adamson, A. W., *J. Amer. Chem. Soc.*, **69**, 2818 (1947).
3. Kunin, R., and Myers, R. J., *J. Amer. Chem. Soc.*, **69**, 2874 (1947).
4. Bauman, W. C., "Fundamental Properties of Ion Exchange Resins" in F. C. Nachod, "Ion Exchange," Academic Press, Inc., New York (1949).
5. Gregor, H. P., Taifer, M., Citarel, L., and Becker, E. I., *Ind. Eng. Chem.*, **44**, 2834 (1952).
6. Cornaz, J. P., Deuel, H., *Experientia*, **10**, No. 3, 137, Basel (1954).
7. Skogseid, A., Ph.D. dissertation, Norges Tekniske Hogskole, Trondheim (1946).
7a. Cassidy, H. G., Ezrin, M., and Updegraff, I. H., *J. Amer. Chem. Soc.*, **75**, 1615 (1953).
8. Beohner, H. L., and Mindler, A. B. *Ind. Eng. Chem.*, **41**, 448 (1949).
9. Hussey, S. J., U. S. Bureau of Mines Report of Investigations 4374 (January 1949).
10. Hiester, N. K., Phillips, R. C., Fields, E. F., Cohen, R. K. and Radding, S. B., *Ind. Eng. Chem.*, **45**, 2402 (1953).
11. Mindler, A. B., and Paulson, C. F., *J. Metals*, **5**, 980 (1953).
12. Weil, H., *Canad. Chem. Proc. Ind.*, 33, 956 (1949).
13. Barnebl, A. C., and Riker, W. J., U. S. Patent 2,595,627 (May 6, 1952).
14. Rawlings, F. N., U. S. Patent 2,413,-844 (January 7, 1947).
15. Streicher, L., and Bowers, A. E., *J. Amer. Water Works Assn.*, **42**, 87 (January 1950).
16. Kunin, R., and Myers, R. J., "Ion Exchange Resins," p. 87, John Wiley & Sons, Inc., New York (1950).
17. Monet, G. P., *Chem. Eng.*, **57**, 106 (Mar. 1950).
18. Thomas, H. C., *J. Amer. Chem. Soc.*, **66**, 1664 (1944), and *Annals New York Acad. Sci.*, **49**, 161 (1948).
19. Hiester, N. K., and Vermeulen, T., *Chem. Eng. Progress*, **48**, 505 (1952).
20. Michaels, A. S., *Ind. Eng. Chem.*, **44**, 1922 (1952).
21. Glueckauf, E., and Coates, J. I., *J. Chem. Soc.*, 1315 (1947).
22. Gilliland, E. R., and Baddour, R. F., *Ind. Eng. Chem.*, **45**, 330 (1953).
23. Vermeulen, T., and Hiester, N. K., *Ind. Eng. Chem.* **44**, 636 (1952).
24. Opler, A., and Hiester, N. K., "Tables for Predicting the Performance of Fixed Bed Ion Exchange and Similar Mass Transfer Processes," Stanford Research Institute, Stanford, Calif. (1954).
25. Hiester, N. K., Radding, S. B., Nelson, R. L., Jr., and Vermeulen, T., "Mass Transfer Rates in Ion Exchange Columns," Manuscript submitted for publication in *Chem. Eng. Progress*.
26. Applebaum, S. B., "Hot Lime Process Followed by Zeolite", paper before Eng. Soc. Western Penna., Pittsburgh, Pa. (Oct. 1950), Cochrane Corp. reprint No. 70.
27. Applebaum, S. B., and McKeown, M. C., "Boiler Feed Water Treatment—Demineralization vs. Evaporation," paper before Wisconsin Utilities Assn., Milwaukee, Wis. (November 12, 1953). Cochrane Corp. reprint No. 85.
28. Various, "Symposium on Mixed Bed Ion Exchange," *Chem. Eng. Progress*, **49**, 341, 437 (1953).
29. Mindler, A. B., *Water and Sewage Works*, **100**, 288 (July 1953).
30. Bickell, L. K., and Trethewey, G. D., *Pulp & Paper Mag. of Canada*, **54**, 13, 110 (1953).
31. Kahler, F. H., Reents, A. C., "Purification of Organic Chemicals by Ion Exchange," Bulletin of Illinois Water Treatment Co.
32. Wheaton, R. M., and Bauman, W. C., *Ind. Eng. Chem.* **45**, 228 (1953).
33. Simpson, B. W., and Wheaton, R. M., *Chem. Eng. Progress*, **50**, 45 (1954).
34. Hutcheon, J. M., "Continuous Ion Exchange," p. 87 of reprint of papers presented at Conference on Ion Exchange and its Application, London University, under the auspices of Society of Chemical Industry (April 1954).
35. Higgins, I. R., and Roberts, J. T., "A Countercurrent Solid-Liquid Contactor for Continuous Ion Exchange," to be published in *Chem. Eng. Progress* Symposium Series on Ion Exchange.
36. Moir, G., Ross, M., and Weiss, D. E., *Australian J. App. Sci.*, **4**, 543 (1953).
37. McCormack, R. H., and Howard, J. F., *Chem. Eng. Progress*, **49**, 404 (1953).
38. Selke, W. A., and Muendel, C. H., "Continuous Ion Exchange with a Cotton Belt," A.E.C. Document NYO-962 (February 15, 1953),.
39. Guthrie, J. D., *Textile Research J.*, **17**, 625 (1947); and *Ind. Eng. Chem.*, **44**, 2187 (1952).
40. Mihara, S., and Terasaki, Y., Jap. Pat. 2223 (1951).
40a. Nordell, C. H., U. S. Pat. Nos. 1,608,661 (Nov. 30, 1926); 1,722,938 (July 30, 1929); 1,740, 199, Dec. 17, 1929).
41. Stanton, L. S., "Continuous Separation By Ion Exchange," M.S. Thesis, University of Washington (1950).
42. Selke, W. A., and Bliss, H., *Chem. Eng. Progress*, **47**, 529 (1951).
43. Hiester, N. K., Fields, E. F., Phillips, R. C., and Radding, S. B., *Chem Eng. Progress*, **50**, 139 (1954).
43a. McIlhenny, W. T., and McConnell, V. O. U. S. Pat. 2,671,714 (Mar. 9, 1954).
44. Dickel, G., and Bohm, G., *Zeitschrift für Elektrochemie*, **57**, 201 (1953).
45. McNeil, R., Swinton, E. A., Weiss, D. E., "Continuous Ion Exchange with Modified Ore Dressing Jig," paper presented at A.I.M.E. Congress, New York (Feb. 1954). Also Swinton, E. A., and Weiss, D. E., *Australian J. Appl. Sci.*, **4**, 316 (1953).
46. Hiester, N. K., Cohen, R. K., and Phillips, R. C., "Engineering and Economic Evaluation of Countercurrent and Fixed Bed Ion Exchange Processes," AEC Document 2739 (June 26, 1953). Also to be published in *Chem. Eng. Progress* Symposium Series on Ion Exchange.
47. Spedding, F. H., and Powell, J. E., "Methods for Separating Rare Earth Elements in Quantity as Developed at Iowa State College," paper presented at Annual Meeting of the A.I.M.E., New York, (Feb. 1954).
48. Stein, W. H., and Moore, S., Cold Spring Harbor Symposia on Quantitative Biology, **14**, 179 (1950).
49. Wiechers, S. G., and Van Hoek, C., *Research*, London, **6**, 192 (1953).
50. Spiegler, K. S., *J. Electrochem. Soc.*, **100**, 303C (1953).
51. Anon., Second Annual Report of Secretary of Interior on Saline Water Conversion (January 1954).
52. Anon., U. S. Dept. of Interior Saline Water Conversion Program, Research and Development Report No. 1, "Results of Selected Laboratory Tests of an Ionics Demineralizer" (April 1954).
53. Anon., *Chem. Eng. News*, **31**, 4024 (1953).
54. Ellis, C. B., "Fresh Water from the Ocean," Ronald Press, New York (1954).
55. Bramer, H. C., and Coull, J., "Electrolytic Regeneration of Spent Pickling Solution," paper at Kansas City meeting of the Amer. Chem. Soc. (March, 1954).
56. Weaver, H. E., Personal Communication (Feb. 15, 1954).





The Fuller preheater (Humboldt suspension type) at Evansville, Pa., a $300,000 experiment aimed at . . .

Capturing Rotary Kiln Heat

The added advantages of increased production and decreased labor costs have stimulated American engineering interest in the thermal efficiency of rotary kilns. Here's our round-up of recent advances.

EDITORIAL STAFF

At various times in the past several years we have received bits of information about new developments in rotary kiln design. As we checked on the accuracy and news value of this information by writing to and talking to some experts on the subject, we were surprised (quite frankly) at the interest that American engineers are showing in, and the time that they are spending on, this relatively static field. The reason for their interest might be explained this way.

A man's wages for four hours' work in Pennsylvania buys a ton of coal wholesale. The German worker has to work ten times as long to buy a ton of coal.[1] Because of the high fuel cost in Germany, Sweden, Switzerland and other parts of Western Europe, high thermal efficiency has been the first objective of cement producers and manufacturers of rotary kilns.

In North America, labor is the principle cost item and although we are becoming increasingly concerned with rising fuel costs, high clinker production is of first importance. Some recent installations of longer dry process kilns were disappointing because they failed to make satisfactory reductions in exit gas temperatures when production was held at an acceptable level.[2]

However, some of the very latest designs such as the Fuller preheater (Humboldt suspension type) illustrated above show promise as savers of fuel and labor costs. In addition they give increased throughput. There are some exceptionally good reports also about a double-pass Lepol, or ACL, kiln system installed in a Swedish

plant about two years ago.[7] And, primarily for modernization of existing shorter kilns, the Swiss Holderbank-Gygi system has established a reputation for fuel economy (as much as a 21 percent savings in some cases[8]) and for increased production also.[7]

WHAT DID THEY DO BEFORE?

Shaft kilns for burning cement disappeared in the United States two generations ago as uneconomical. Due to the shaft kiln's low capital investment, fuel cost and greatly improved operation, it still is used to a small extent in Europe and is even included in some new plants now in planning.[6]

The rotary kiln is essentially an American development. It is remarkable for its adaptability to burn various mineral, chemical or ceramic products and today is unsurpassed for high quality, uniformity of burn and large output. We've shown the heat flow in a rotary kiln in the sketch below.

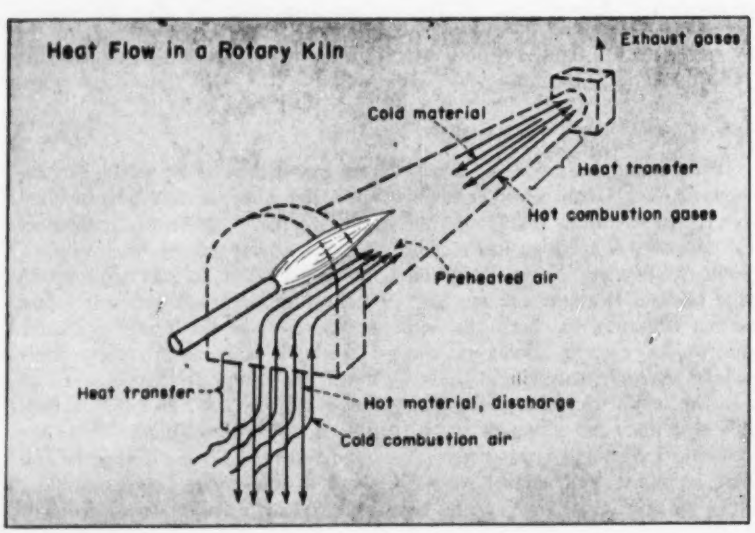
About 25 years ago the rotary kiln was extremely wasteful in fuel consumption. Frequently red-hot exit gases came out of the stacks and white-hot cement clinker was thrown onto the clinker pile. The fuel consumption in these older kilns was around 2,000,000 Btu. per barrel or about three times higher than the best modern practice.

Waste heat at the feed end of the kiln was and in some cases is still utilized to produce steam for power generation, but this method of heat saving is preferably replaced now by methods of preheating the incoming raw mixture.

The single-pass Lepol kiln was introduced about 1930. Instead of generating steam, the exit gas is utilized more efficiently by transmitting it into a layer of pelletized incoming raw mixture of cement. The length of the rotary kiln was cut from one-third to one-half. The fuel consumption per barrel for dry process cement was decreased to somewhere near 700,000 Btu. per barrel.[8]

We know that the rotary kiln, when running typically slowly is an extremely poor mixer. Rapid contact of hot gas and material occurs only to a strictly limited extent. The actual effect in the kiln is that of material rolling in a constricted path on the surface of the mass. Lengthening the contact time between hot gases and the material can be achieved by reducing the rotation rate of the kiln. But this tends to give poorer rather than better mixing. It also reduces output. Lengthening the contact time by lengthening the kiln itself reaches a practical limit at about 400 ft. And this can by no means be regarded as an ideal solution.[8]

Many people are firmly convinced that thermal efficiencies of long kilns without waste heat recuperation are unsatisfactory. There are some who advocate the adoption of a wet process where the raw materials permit. Others feel that the solution is a dry process kiln with a preheater (either external or internal).



WET PROCESS EXCHANGERS

For wet processes, every other form of heat exchanger falls into complete insignificance when compared with slurry evaporating chains. These were introduced in the late 1920's. The use of these chains is almost universal in wet process plants without waste heat recuperation. Their introduction paralleled that of the long (say over 250 ft.) wet kiln. No long wet kilns are ever operated today without chains. Evaporating chains are the outstanding example of an innovation which was accepted and has become part of the wet process.

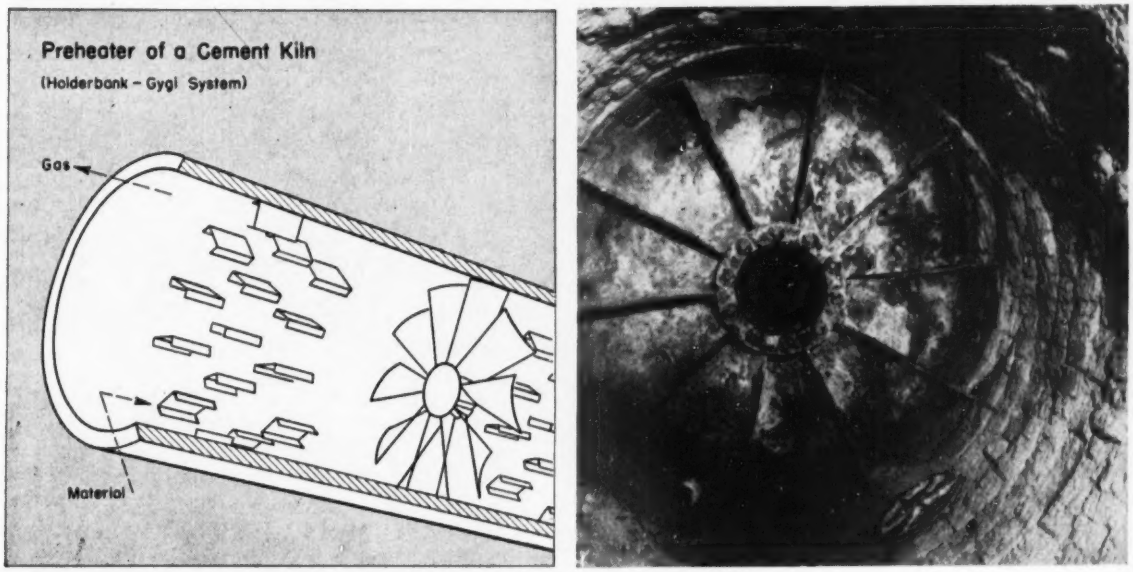
Other forms of heat exchangers have been tried, have developed certain defects and have either struggled along with a few installations or have gradually died out. These include:

- The MIAG (German) external calcinator in which the slurry passes through a bed of "loose" bodies in a slowly rotating drum.
- A whole family of partitions, lifters and honeycombs intended to lift and cascade the wet slurry inside the kiln. The Polysius "silo kiln" was one example of this.
- The spray system in which slurry was sprayed in a curtain into the feed end of the kiln.
- The Lang recuperator in which slurry is violently flung up by a rotating paddle in a rotating drum.

DRY PROCESS EXCHANGERS

In the dry process there has been, until recently, nothing to compare with the evaporating chains of the wet process. Usually the heat exchanger innovations of the dry process have been only partially successful and have found very limited acceptance or have died out. Consequently the gain in thermal efficiency of the dry process kiln has not kept pace over the years with the gain in efficiency of the wet process kiln; even though the dry process is still ahead due to its inherent freedom from having to use heat for evaporating water. The dry process innovations which have found limited acceptance thus far are:

- The Fuller-Humbodlt preheater.
- The Holderbank-Gygi system.
- The double-pass Lepol, or ACL system.



Special baffles and lifters cascade the nodules through the gas stream, improving heat transfer.

We'll try to describe each of these briefly.

FULLER-HUMBOLDT PREHEATER

A suspension type preheater has been developed by Klockner-Humboldt-Deutz AG, of Cologne, Germany, and is now installed in four German cement plants. The first American installation is at the Allentown Portland Cement Co. plant in Evansville, Pa. It was designed and manufactured by the Fuller Co., Humboldt's American licensee. Operation started in May 1953.

The complete kiln assembly is made up of the preheater, a 7 ft. by 125 ft. rotary kiln and a Fuller inclined grate cooler (see illustration p. 181). For experimental purposes, the installation includes a bypass flue whereby all or any desired portion of the kiln exit gases can be diverted directly to the stack.

The preheater includes a raw material supply bin, a series of four cyclone collector stages which with their gas ducts comprise the heat exchange elements of the preheater, a dust collector, exhaust fan and the usual stack. Exit gases from the kiln are drawn up through a vertical duct into the final or fourth stage of the preheater. Similar ducts deliver the gas to the third and second stages. Then the gas stream is divided and passes to two smaller diameter cyclones which form stage 1. From stage 1 the gases pass through a dust collector and fan to the stack.

Raw material is delivered to the system continuously by an air-lift constant head feeder which discharges a stream of constant unit weight at a point between stages 2 and 1. The material is carried by the gas stream up through stage 1 and is collected there. The collected material then passes through balanced gates (which serve as gas locks) and through tubes opening into the gas duct between stage 3 and stage 2.

Stages 2, 3 and 4 are essentially identical, the material ultimately discharging into the kiln feed pipe. The time of gas and material exposure, from initial suspension in stage 1 to final discharge from stage 4 is approximately 20 sec. Dust escaping from stage 1 is collected by four banks of three high efficiency cyclones; the collected dust discharges into the kiln feed pipe in combination with the discharge of stage 4.

All cyclones and ducts below stage 1 are lined with cast refractories 6 in. thick. Stages 2, 3, and 4 have an inside diameter of 9 ft. 10 in. The two cyclones forming stage 1 have inside diameters of 5 ft. 3 in.

Experiments are still in progress. A recent report[2] states, "The capacity of this kiln was increased from 860 to 1,500 barrels per day, with fuel reductions from 1,100,000 Btu. to a range between 650,000 and 750,000 Btu. per barrel while using 60 percent of the total waste gas. As full use of the gas stream is approached, additional kiln production and fuel economy is expected."

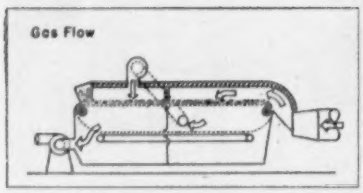
HOLDERBANK-GYGI SYSTEM

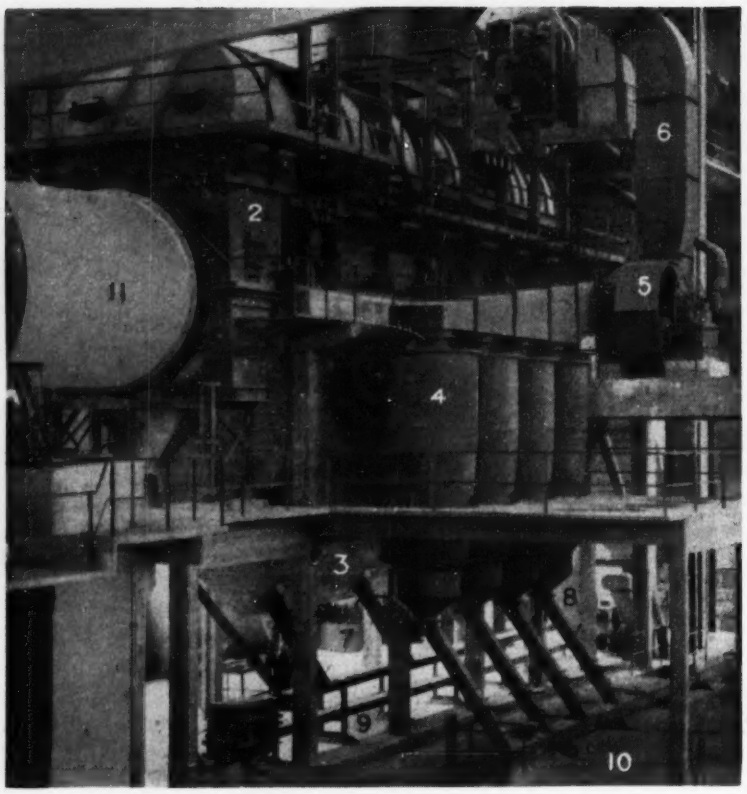
In the Holderbank-Gygi (Swiss) system the material is nodulized. Special baffles and lifters inside the kiln then serve two purposes:

(1) Gas baffles cause the gas to whirl, breaking up stratification and improving heat transfer.

(2) Lifters cascade the nodules through the gas stream. The results in a few plants in Switzerland are said to be spectacular but there are no installations in this country at present.

We have some details on a Swedish installation that was started in March of 1953, and is the largest kiln using this system. The kiln diameter is 10 ft. 5 in. at the feed end, 9 ft. and 10 ft. in the burning zones, and 290 ft. long. The guaranteed performance for this kiln was to be not less than 2,200 barrels per day with an exit gas between 410-455 deg. F. and the quan-





Lepol-ACL System

1 Pelletizing pan
2 Upper part of furnace
3 Lower part of furnace
4 Cyclone after first pass
5 Fan for first pass
6 Gas duct to predrying
7-10 Enclosed chutes and transporting devices taking dust into the rotary kiln
11 Rotary kiln

tity of dust was not to exceed 30 percent of the clinker product.

Some test data show a production of 2,450 barrels per day, exit gas temperature of 430 deg. F. and fuel consumption approximately 720,000 Btu. per barrel.[7]

LEPOL-ACL SYSTEM

In the new double-pass Lepol or ACL (for Allis-Chalmers-Lellep) system a great reduction in fuel consumption is achieved by utilizing the heat of the exit gases of a rotary kiln for drying and pre-burning a bed of pelletized raw material on a traveling grate. The gases make two passes through the grate.

The second pass at the feed end of the grate pre-dries the raw material while the initial gas pass at the discharge end of the grate preheats and partially calcines the raw material.

Complete decarbonization and clinkering is then effected in the short rotary kiln at temperatures from 1800-2700 deg. F. Exit gases from the kiln at about 1800 deg. F. are drawn by a fan through the grate and final discharge gas temperature is somewhat below 212 deg. F.

A Swedish installation of the Lepol system started operating in Sept. of 1952. The kiln is 290 ft. long. The guaranteed performance was 3,000 barrels per day at 655,000 Btu. per barrel. Test data show a production rate of 3,300 barrels per day at 560,000 Btu. per barrel and an exit gas temperature of 160 deg. F. Clinker discharges from a rotary cooler at 430 deg. F.[7]

ACKNOWLEDGEMENTS

We wish to acknowledge the assistance of the following individuals who answered our inquiry during the preparation of this article: F. W. Argue, W. R. Bendy, C. Clauson, W. S. Dickie, G. K. Engelhart, H. Gygi, B. R. Jacobsen, C. L. Knowles, G. Niemitz, F. H. Stratman, H. W. Tock, A. B. Zahn.

In addition the assistance of the following companies is acknowledged: Allis-Chalmers Manufacturing Co., Milwaukee; W. R. Bendy Cement Engineers, St. Louis; Fuller Co., Catasauqua, Pa.; General American Transportation Co., New York; Holderbank-Wildegg Ltd., Holderbank, Switzerland; Kennedy-Van Saun Engineering and Mfg. Co., New York; Knowles Associates, New York; Stone & Webster Engineering Corp., Boston; Vulcan Iron Works, Wilkes Barre, Pa.; and the Portland Cement Assn., New York.

REFERENCES

1. Bauer, W. G., "How to Control Heat for Calciners," *Chemical Engineering*, May 1954, pp 193-200.

2. Engelhart, G. K., "Suspension Preheating of Dry Pulverized Materials," A.I.M.E. paper, New York (Feb. 15, 1954).

3. Gygi, F., "Thermodynamics of the Cement Kiln," Cement and Concrete Assn., London (Sept. 1952).

4. Jacobsen, B. R., "Rotary Kilns and Their Applicatoin for Various Processes," A.C.S. paper, Los Angeles (Mar. 19, 1953).

5. Lellep, O. G., "Latest Practice of Burning Cement and Lime in Europe," A.I.M.E. paper, New York (Feb. 15, 1954).

6. Pearson, B. M., "Inserted Construction in Rotary Kilns," *Rock Products*, Dec. 1953, p. 121.

7. Tham, H. S. and P. Sylvan, "Producing Clinker at Less Than 700,000 Btu. per Barrell," *Rock Products*, Sept. 1953, p. 78.

Need Help in Finding Cost Data?

SUBJECT INDEX lists 402 individual items involved in chemical engineering economics. Key numbers there refer to the . . .

BIBLIOGRAPHY, listing 351 articles dealing with equipment costs, operating costs, estimating methods and project analysis.

JAMES B. WEAVER

Publication of a great mass of literature on cost estimation within the past eight years, while solving some problems, has created another.

Among the problems solved are the education of young engineers in the techniques of cost estimation and the greater availability of authoritative dollar figures and estimating factors.

The problem created: How do you find specific wanted information from this large volume of literature? This bibliography and subject index represent an attempt to answer this problem.

Included here are published references, through 1953, which discuss estimating techniques or contain data on operating or capital costs. Several articles and books deal with general aspects of engineering economics. A few items on tool and machining cost estimation should be of interest to chemical engineers.

First two digits of reference numbers indicate year of publication; alphabetical order (by author) prevails for any given year. Material published prior to 1947 is not covered as thoroughly as more recent material; some of it is included chiefly for historical interest.

Jim Weaver has recently joined the planning staff of Atlas Powder Co., Wilmington, Del. Prior to that he was with Olin Industries, East Alton, Ill. He thanks his associates at both Olin and Atlas, especially the library staffs, for their help in preparation of this bibliography.

Barnet's "Bibliography of Investment and Operating Costs for Chemical and Petroleum Plants" (Ref. No. 4901) may provide additional source material in special cases. It includes references discussing particular plants and processes, which are generally omitted here.

Preparation of a complete, perfect subject index is impractical, if not altogether impossible. Users of this bibliography may have to exercise some knowledge of the subject matter in order to locate all pertinent references. For example, vacuum devices may be listed in several different places, such as: Pumps, gas; Pumps, high vacuum; Ejectors; etc.

What kind of material is needed in today's literature on cost estimation? Certainly not more on estimating *methods;* take a look at the number of references under that heading. Methods of estimating have made only a few major advances since Becket's article in 1926 (Ref. No. 2601).

What's needed is more *cost data* on all sorts of equipment, and the more *correlated* data curves you can publish the better. This is where contributors to the literature can be of the most help.

Note—Author and editor alike realize that in a work of this magnitude accidental introduction of errors is almost unavoidable. In addition, certain worthwhile references may have been overlooked completely. We invite comment or criticism from readers regarding errors of omission or commission.—Editor.

SUBJECT INDEX

Look here for key numbers to bibliography.

Absorbers (see Towers)
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"For which of you, intending to build a tower, sitteth not down first, and counteth the cost, whether he have sufficient to finish it? Lest haply, after he hath laid the foundation, and is not able to finish it, all that behold it begin to mock him, saying, this man began to build, and was not able to finish." ***St. Luke 14:28-30.***

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BIBLIOGRAPHY

Look here for literature references corresponding to key numbers listed in the subject index.

1926-1946

No.	AUTHOR	TITLE	REFERENCE
2601...	Becket, F. M.	"Failure to Make Full Cost Analyses Wastes Technical Efforts"..	*Chem. Met. Eng.*, **33**, 283–6 (May 1926)
3201...	Anonymous	"Chemical Costs"	*Chem. Met. Eng.*, **39**, 1–8 (Jan. 1932)
3202...	McNeice, T. M.	"An Engineer Looks at Distribution"	*Chem. Met. Eng.*, **39**, 9–12 (Jan. 1932)
3801...	Anonymous	"Depreciation Rates for Process Equipment"	*Chem. Met. Eng.*, **45**, 80, 99 (Feb. 1938)
3802...	Mahr, H. W.	"Catalysis Costs Determine Economy in Contact Processes"	*Chem. Met. Eng.*, **45**, 313–7 (June 1938)
4101...	Bilbe, C. W.	"What Soybean Processing Costs"	*Chem. Met. Eng.*, **48**, 85 (Apr. 1941)
4102...	Bliss, H.	"The Costs of Process Equipment and Accessories"	*Trans. AIChE*, **37**, 763–804 (Oct. 25, 1941); reprinted, modified, *Chem. Met. Eng.*, **48**, 87–98 (Dec. 1941)
4103...	Rounds, H. P., Kiernan, J. T.	"Building Fabrication and Comparative Costs"	*Chem. Met. Eng.*, **48**, 104–6 (May 1941)
4104...	Schaphorst, W. F.	"Calculating Construction Costs"	*Chem. Eng. News*, **19**, 1151 (Oct. 25, 1941)
4301...	Brummerstedt, E. F.	"Design and Construction of a 33-Foot Diameter, Arc-Welded, Vacuum Fractionating Tower"	*Nat. Petr. News*, **35**, R74–6, 78–80, 82–3 (Feb. 3, 1943)
4302...	Fowler, F. C., Brown, G. G.	"Cost of Pressure Vessels and Pressure Fractionating Columns"..	*Trans. AIChE*, **39**, 241–254 (April 25, 1943)
4303...	Zimmerman, O. T., Lavine, I.	"Chemical Engineering Laboratory Equipment"	Industrial Research Service, Dover, N. H., 1943

No	AUTHOR	TITLE	REFERENCE
4401	Brummerstedt, E. F.	"Discussing Economic Design of Modern Pressure Vessels"	*Nat. Petr. News*, **36**, R282–3 (May 3); R362–4 (June 7); R477 (July 5); R603–4 (Sept. 6); R684 (Oct. 4, 1944)
4402	Gilliland, E. R. Lavender, H. M.	"Plant Investment & Production Costs for Synthetic Rubber"	*Chem. Met. Eng.*, **51**, 126–131 (Oct. 1944)
4501	Bennett, L.	"Depreciation of Buildings, Plant, and Machinery"	*Mech. World Eng. Record*, **118**, 455–8 (Oct. 26, 1945)
4502	Reynolds, M. M.	"Process Economic Analysis Aided by New Graphical Method"	*Chem. Met. Eng.*, **52**, 104–6 (Aug. 1945)
4503	Theisinger, W. G.	"Fabrication Costs of Boilers, Tanks and Pressure Vessels as Affected by Plate Widths"	*Petr. Refiner*, **24**, 121–7 (Feb. 1945)
4601	Andersen, S. E.	"How to Determine Economical Batch Sizes"	*Chem. Met. Eng.*, **53** 137 (July 1946)
4602	Caldwell, H. B. Kohlins, W. D.	"Some Aspects of the Economics of Evaporation"	*Trans. AIChE*, **42**, 495–509 (June 25, 1946)
4603	Eckhardt, H.	"Needed: Standard Cost Estimating Data for the Process Industries"	*Chem. Eng.*, **53**, 104–5 (Sept. 1946)
4604	Field, J. H.	"Electric Generating Plants—A Discussion of Installation Costs"	*Oil Gas J.*, **45**, 106, 109, 112, 114, 117, 118, 121 (June 22, 1946)
4605	Happel, J. Aries, R. S., Borns, W. J.	"Estimating Chemical Engineering Equipment Costs"	*Chem. Eng.*, **53**, 99–102 (Oct. 1946)
4606	Happel, J. Aries, R. S., Borns, W. J.	"Equipment Costs and Other Items in Engineering Economics"	*Chem. Eng.*, **53**, 97–100 (Dec. 1946)

1947

4701	Anonymous	"Buildings Costs"	*Chem. Eng.*, **54**, 111 (May 1947)
4702	Anonymous	"Equipment Freight Cost"	*Chem. Eng.*, **54**, 125 (May 1947)
4703	Anonymous	"Estimating Spray Dryers"	*Chem. Eng.*, **54**, 125 (May 1947)
4704	Anonymous	"Indexes in the Plant Cost Picture"	*Chem. Eng.*, **54**, 109–111 (May 1947)
4705	Anonymous	"Process Equipment Cost Estimation"	*Chem. Eng.*, **54**, 107–8 (May 1947)
4706	Anonymous	"Refrigeration Costs"	*Chem. Eng.*, **54**, 125 (May 1947)
4707	Behrens, J. R.	"Estimating Installations of Chemical Equipment"	*Chem. Eng.*, **54**, 106–7 (July 1947)
4708	Bliss, H.	"Data for Equipment Cost Estimates"	*Chem. Eng.*, **54**, 126–138 (May 1947); 100–2 (June 1947)
4709	Brown, C. O.	"Complete Ammonia Plants"	*Chem. Eng.*, **54**, 124 (May 1947)
4710	Bryant, G. A.	"Plant Design for Minimum Cost"	*Chem. Eng.*, **54**, 113–6 (Mar. 1947)
4711	Buell, W. H.	"Calculating Payout Time for Equipment Investments"	*Chem. Eng.*, **54**, 97 (Oct. 1947)
4712	Bullock, H. L.	"Vibrating Screen Estimation"	*Chem. Eng.*, **54**, 97–9 (June 1947)
4713	Considine, D. M.	"Estimation of Instrument Costs"	*Chem. Eng.*, **54**, 108–9 (July 1947)
4714	Dickson, R. A.	"Determining Cost of Tanks, Spheres and Drums"	*Chem. Eng.*, **54**, 122 (Aug. 1947)
4715	Dickson, R. A.	"How 'N' System Simplifies Piping Cost Estimation"	*Chem. Eng.*, **54**, 121–3 (Nov. 1947)
4716	Eckhardt, H.	"Price and Cost—An Analysis"	*Chem. Eng.*, **54**, 108 (May 1947)
4717	Eckhardt, H.	"Centrifugal Separator Costs"	*Chem. Eng.*, **54**, 121–3 (May 1947)
4718	Fox, L. E.	"Estimation of Field-Erected Tanks"	*Chem. Eng.*, **54**, 100–1 (Aug. 1947)
4719	Hauck, C. F.	"Influence of Wastes on Treatment and Use of Water"	*Chem. Eng. Prog.*, **43**, 481–6 (Sept. 1947)
4720	Jackson, D. H.	"Ejectors and Condensers"	*Chem. Eng.*, **54**, 123–4 (May 1947)
4721	Kinckiner, R. A.	"Investments and the Engineer"	*Chem. Eng. Prog.*, **43**, 183–8 (Apr. 1947)
4722	Lang, H. J.	"Engineering Approach to Preliminary Cost Estimates"	*Chem. Eng.*, **54**, 130–3 (Sept. 1947)
4723	Lang, H. J.	"Cost Relationships in Preliminary Cost Estimates"	*Chem. Eng.*, **54**, 117–121 (Oct. 1947)
4724	Otto, F. C.	"Estimating Cold Insulation Costs"	*Chem. Eng.*, **54**, 118 (May 1947)
4725	Otto, F. C.	"Estimating Mineral Wool Insulation"	*Chem. Eng.*, **54**, 102–6 (July 1947)
4726	Otto, F. C.	"Estimating Magnesia Insulation Costs"	*Chem. Eng.*, **54**, 126–9 (Sept. 1947)
4727	Schrader, R. J.	"Estimating Chemical Piping Costs"	*Chem. Eng.*, **54**, 109–110 (Jan. 1947)
4728	Sieder, O. E.	"Considerations in Industrial Plant Site Cost"	*Chem. Eng.*, **54**, 117 (May 1947)
4729	Stevens, R. W.	"Equipment Cost Indexes for Process Industries"	*Chem. Eng.*, **54**, 124–6 (Nov. 1947)
4730	Wilcoxon, B. H.	"Unit Cost of Some Complete Plants"	*Chem. Eng.*, **54**, 112 (May 1947)
4731	Williams, R.	"Standardizing Cost Data on Process Equipment"	*Chem. Eng.*, **54**, 102–3 (June 1947)
4732	Williams, R.	"Pricing New Products for Maximum Profit"	*Chem. Ind.*, **61**, 622–4, 682 (Oct. 1947)
4733	Williams, R.	"'Six-Tenths Factor' Aids in Approximating Costs"	*Chem. Eng.*, **54**, 124–5 (Dec. 1947)

1948

4801	Coe, E. H.	"These Short Cuts Will Speed Your Design and Estimation of Tanks"	*Chem. Eng.*, **55**, 107–9 (Sept. 1948)
4802	Harris, J. M.	"Chemical Engineering Economics"	*Chem. Eng. Prog.*, **44**, 333–5 (Apr. 1948)
4803	How, H.	"Short-Cut Estimation of Welded Process Vessels"	*Chem. Eng.*, **55**, 122–6 (Jan. 1948)
4804	Kominek, E. G.	"Evaluation of Demineralization Methods"	*Chem. Eng. Prog.*, **44**, 697–702 (Sept. 1948)
4805	Lang, H. J.	"Simplified Approach to Preliminary Cost Estimates"	*Chem. Eng.*, **55**, 112–3 (June 1948)
4806	Macrow, L. Bowman, U. A.	"Air Conditioning"	Encyclopedia of Chemical Technology, Vol. 1, p. 251–2, Interscience, New York, 1948
4807	Nelson, W. L.	"Costimating—Construction Cost Indexes"	*Oil Gas J.*, **47**, 141 (Oct. 21, 1948)
4808	Nelson, W. L.	"Costimating—Exchangers"	*Oil Gas J.*, **47**, 117 (Oct. 28, 1948)
4809	Nelson, W. L.	"Costimating—Construction Steel"	*Oil Gas J.*, **47**, 111 (Nov. 4, 1948)
4810	Nelson, W. L.	"Costimating—Use of Cost Indexes"	*Oil Gas J.*, **47**, 387 (Nov. 11, 1948)
4811	Nelson, W. L.	"Costimating—Storage Tanks"	*Oil Gas J.*, **47**, 123 (Nov. 18, 1948)
4812	Nelson, W. L.	"Costimating—Petrochemical and Small Tanks"	*Oil Gas J.*, **47**, 133 (Nov. 25, 1948)
4813	Nelson, W. L.	"Costimating—Lumber"	*Oil Gas J.*, **47**, 115 (Dec. 2, 1948)
4814	Nelson, W. L.	"Costimating—Summary Sheets for Cost Estimates"	*Oil Gas J.*, **47**, 117 (Dec. 9, 1948)
4815	Nelson, W. L.	"Costimating—Vessels"	*Oil Gas J.*, **47**, 113 (Dec. 16, 1948)
4816	Nelson, W. L.	"Costimating—Special Vessels"	*Oil Gas J.*, **47**, 81 (Dec. 23, 1948)
4817	Nelson, W. L.	"Costimating—Fractionating Towers"	*Oil Gas J.*, **47**, 277 (Dec. 30, 1948)
4818	Pierce, D. E.	"A Common Denominator for Repair Costs"	*Chem. Eng. Prog.*, **44**, 249–252 (Mar. 1948)
4819	Rubin, F. L.	"Shell and Tube Heat Exchangers"	*Petr. Refiner*, **27**, 139–145 (July 1948)
4820	Whistler, A. M.	"Heat Exchangers As Money Makers"	*Petr. Refiner*, **27**, 83–6 (Jan. 1948)

1949

4901	Barnet, W. I.	"Bibliography of Investment and Operating Costs for Chemical and Petroleum Plants"	*U. S. Bureau of Mines*, I.C. 7516 (Oct. 1949)
4902	Boyd, J. H.	"Should Chemicals Move by Pipeline?"	*Chem. Ind.*, **65**, 349, 461 (Sept. 1949)
4903	Chilton, C. H.	"Cost Data Correlated"	*Chem. Eng.*, **56**, 97–106 (June 1949)

COST ESTIMATION INDEX . . .

No.	AUTHOR	TITLE	REFERENCE
4904	Dickson, R. A.	"Labor Cost of Installing Piping"	*Chem. Eng.*, **56**, 97–98 (Apr. 1949)
4905	Fox, L. E.	"Estimate the Cost of a Screw Conveyor"	*Chem. Eng.*, **56**, 128–130 (Nov. 1949)
4906	Horridge, E. T.	"The Economics of Motor Voltage Selection"	*Petr. Refiner*, **28**, 133–9 (May 1949); 157–161 (July 1949)
4907	Kohl, W. H.	"Performance Data for High-Vacuum Pumps"	*Iron Age*, **164**, 59–63 (July 28, 1949)
4908	Nelson, W. L.	"Costimating—Estimate of a Fractionator"	*Oil Gas J.*, **47**, 93 (Jan. 6, 1949)
4909	Nelson, W. L.	"Costimating—Tower Insulation and Platforms"	*Oil Gas J.*, **47**, 101 (Jan. 13, 1949)
4910	Nelson, W. L.	"Costimating—Simplified Cost Estimates"	*Oil Gas J.*, **47**, 97 (Jan. 20, 1949)
4911	Nelson, W. L.	"Costimating—Pipe Insulation"	*Oil Gas J.*, **47**, 351 (Jan. 27, 1949)
4912	Nelson, W. L.	"Amortization and Depreciation Rates"	*Oil Gas J.*, **47**, 90 (Feb. 3, 1949)
4913	Nelson, W. L.	"Costimating—Insulation for Cold—1"	*Oil Gas J.*, **47**, 91 (Feb. 3, 1949)
4914	Nelson, W. L.	"Costimating—Insulation for Cold—2"	*Oil Gas J.*, **47**, 107 (Feb. 10, 1949)
4915	Nelson, W. L.	"Costimating—Ladders, Walkways, and Platforms"	*Oil Gas J.*, **47**, 137 (Feb. 17, 1949)
4916	Nelson, W. L.	"Costimating—Depreciation Rates—Refining"	*Oil Gas J.*, **47**, 187 (Feb. 24, 1949)
4917	Nelson, W. L.	"Costimating—Clay and Cement Pipe"	*Oil Gas J.*, **47**, 99 (Mar. 3, 1949)
4918	Nelson, W. L.	"Costimating—Depreciation Rates—Petroleum"	*Oil Gas J.*, **47**, 111 (Mar. 10, 1949)
4919	Nelson, W. L.	"Costimating—Cost of Buildings"	*Oil Gas J.*, **47**, 191 (Mar. 17, 1949)
4920	Nelson, W. L.	"Costimating—Pump and Control Houses"	*Oil Gas J.*, **47**, 303 (Mar. 24, 1949)
4921	Nelson, W. L.	"Costimating—Brick and Tile"	*Oil Gas J.*, **47**, 125 (Mar. 31, 1949)
4922	Nelson, W. L.	"Costimating—Pipe Stills"	*Oil Gas J.*, **47**, 109 (Apr. 7, 1949)
4923	Nelson, W. L.	"Costimating—Furnace Details"	*Oil Gas J.*, **47**, 125 (Apr. 14, 1949)
4924	Nelson, W. L.	"Costimating—Tubes and Bends"	*Oil Gas J.*, **47**, 243 (Apr. 21, 1949)
4925	Nelson, W. L.	"Costimating—Structural Steel Frames"	*Oil Gas J.*, **47**, 141 (Apr. 28, 1949)
4926	Nelson, W. L.	"Costimating—Centrifugal Pumps"	*Oil Gas J.*, **47**, 103 (May 5, 1949)
4927	Nelson, W. L.	"Costimating—Pump Materials and Drives"	*Oil Gas J.*, **48**, 121 (May 12, 1949)
4928	Nelson, W. L.	"Costimating—Large Motors"	*Oil Gas J.*, **48**, 363 (May 19, 1949)
4929	Nelson, W. L.	"Costimating—Electrical Equipment"	*Oil Gas J.*, **48**, 115 (May 26, 1949)
4930	Nelson, W. L.	"Costimating—Petrochemical Filter Press Costs"	*Oil Gas J.*, **48**, 81 (June 2, 1949)
4931	Nelson, W. L.	"Costimating—Instrumentation"	*Oil Gas J.*, **48**, 101 (June 9, 1949)
4932	Nelson, W. L.	"Costimating—Instrument Costs"	*Oil Gas J.*, **48**, 141 (June 16, 1949)
4933	Nelson, W. L.	"Costimating—Compressors"	*Oil Gas J.*, **48**, 223 (June 23, 1949)
4934	Nelson, W. L.	"References to Costs"	*Oil Gas J.*, **48**, 81 (June 30, 1949)
4935	Nelson, W. L.	"Costimating—Blowers and Compressors"	*Oil Gas J.*, **48**, 91 (June 30, 1949)
4936	Nelson, W. L.	"Costimating—Refrigeration Plants"	*Oil Gas J.*, **48**, 95 (July 7, 1949)
4937	Nelson, W. L.	"Costimating—Refrigeration Auxiliaries"	*Oil Gas J.*, **48**, 111 (July 14, 1949)
4938	Nelson, W. L.	"Costimating—Construction Costs 1948–49"	*Oil Gas J.*, **48**, 101 (July 21, 1949)
4939	Nelson, W. L.	"Costimating—Structural Steel—Pipe Stills, etc."	*Oil Gas J.*, **48**, 339 (July 28, 1949)
4940	Nelson, W. L.	"Costimating—Piping and Tubing"	*Oil Gas J.*, **48**, 65 (Aug. 4, 1949)
4941	Nelson, W. L.	"Costimating—Chemical Equipment—I"	*Oil Gas J.*, **48**, 109 (Aug. 11, 1949)
4942	Nelson, W. L.	"Costimating—Pipe-Line Construction"	*Oil Gas J.*, **48**, 159 (Aug. 18, 1949)
4943	Nelson, W. L.	"Costimating—Refinery Valves"	*Oil Gas J.*, **48**, 143 (Aug. 25, 1949)
4944	Nelson, W. L.	"Costimating—Fittings and Flanges"	*Oil Gas J.*, **48**, 71 (Sept. 1, 1949)
4945	Nelson, W. L.	"Costimating—Chemical Equipment—II"	*Oil Gas J.*, **48**, 107 (Sept. 8, 1949); see correction, **48**, 97 (Nov. 3, 1949)
4946	Nelson, W. L.	"Costimating—Piping"	*Oil Gas J.*, **48**, 137 (Sept. 15, 1949)
4947	Nelson, W. L.	"Costimating—Vacuum Equipment"	*Oil Gas J.*, **48**, 299 (Sept. 22, 1949)
4948	Nelson, W. L.	"Costimating—Coil-in-Box Equipment"	*Oil Gas J.*, **48**, 91 (Sept. 29, 1949)
4949	Nelson, W. L.	"Costimating—Chemical Equipment—III"	*Oil Gas J.*, **48**, 343 (Oct. 6, 1949)
4950	Nelson, W. L.	"Costimating—Excavations, Concrete, and Foundations"	*Oil Gas J.*, **48**, 135 (Oct. 13, 1949)
4951	Nelson, W. L.	"Costimating—Road Building"	*Oil Gas J.*, **48**, 135 (Oct. 20, 1949)
4952	Nelson, W. L.	"Costimating—Fire Protection and Miscellaneous"	*Oil Gas J.*, **48**, 91 (Oct. 27, 1949)
4953	Nelson, W. L.	"Costimating—Refinery Labor"	*Oil Gas J.*, **48**, 97 (Nov. 3, 1949)
4954	Nelson, W. L.	"Costimating—Steam-Jet Ejectors and Freight Rates"	*Oil Gas J.*, **48**, 377 (Nov. 10, 1949)
4955	Nelson, W. L.	"Costimating—Effect of Size on Cost"	*Oil Gas J.*, **48**, 103 (Nov. 17, 1949)
4956	Nelson, W. L.	"Costimating—Over-All Plant Costs, Cracking"	*Oil Gas J.*, **48**, 149 (Nov. 24, 1949)
4957	Nelson, W. L.	"Costimating—Over-All Plant Costs, Distillation, etc."	*Oil Gas J.*, **48**, 93 (Dec. 1, 1949)
4958	Nelson, W. L.	"Costimating—Over-All Plant Costs; Misc."	*Oil Gas J.*, **48**, 91 (Dec. 8, 1949)
4959	Nelson, W. L.	"Costimating—A Refinery Cost Index"	*Oil Gas J.*, **48**, 91 (Dec. 15, 1949)
4960	Nelson, W. L.	"Costimating—Current Itemized Indexes"	*Oil Gas J.*, **48**, 383 (Dec. 22, 1949)
4961	Nelson, W. L.	"Costimating—Alphabetical Index"	*Oil Gas J.*, **48**, 81 (Dec. 29, 1949)
4962	Reichard, H. F.	"Graphical Analysis Assures Correct Investment for Saving"	*Chem. Eng.*, **56**, 133 (Nov. 1949)
4963	Reynolds, B. M.	"Economics of Plant Expansion"	*Chem. Eng.*, **56**, 151–2 (May 1949)
4964	Soule, R. P.	"Research Economics: Postwar vs. Prewar"	*Chem. Ind.*, **65**, 196–200 (Aug. 1949)
4965	Tyler, C.	"Chemical Engineering Economics"	3rd ed., McGraw-Hill, New York, 1948
4966	VanNoy, C. W., Dunville, T. C., Dressler, R. G., Chaffee, C. C.	"Guide for Making Cost Estimates for Chemical-Type Operations"	*U. S. Bureau of Mines*, R.I. 4534 (Nov. 1949)
4967	Vilbrandt, F. C.	"Chemical Engineering Plant Design"	3rd ed., Chap XIII, "Preconstruction Cost Estimating," p. 410–544, McGraw-Hill, New York, 1949
4968	Wright, C. C.	"Alternate Fuels for the Ceramic Industry"	*Am. Cer. Soc. Bull.*, **28**, 1–6 (Jan. 15, 1949)

1950

5001	Aries, R. S., Newton, R. D.	"Chemical Engineering Cost Estimation"	Chemonomics, New York, 1950
5002	Aries, R. S.	"Plant Location"	Encyclopedia of Chemical Technology, Vol. 10, p. 744–754, Interscience, New York, 1950
5003	Ashton, H. W., Meiklejohn, G. T.	"Cost Estimating in Process Development"	*Soc. Chem. Ind., Proc ,Chem. Eng. Group*, **32**, 27–38 (1950)
5004	Bayard, R. A.	"Pick Off Economic Insulation Thickness"	*Chem. Eng.*, **57**, 142–4 (June 1950)
5005	Bohmfalk, J. F.	"Synthetic Rubber"	*Chem. Eng. News*, **28**, 2504–9 (July 24, 1950)
5006	Brooks, G. E.	"How to Estimate Plant Construction Costs"	*Petr. Eng.*, **22**, C7–10 (Mar.); C21, C24, C26–7 (Apr.); C31–6 (June 1950)
5007	Broom, H. P.	"Construction Costs"	*Chem. Eng. News*, **28**, 1109–1111 (Apr. 3, 1950)
5008	Calise, V. J.	"Some Economic Factors in Waste Water Treatment"	*Chem. Eng. Prog.*, **46**, 328–334 (July 1950)
5009	Chilton, C. H.	"'Six-Tenths Factor' Applies to Complete Plant Costs"	*Chem. Eng.*, **57**, 112–4 (Apr. 1950)
5010	Dickson, R. A.	"Pipe Cost Estimation"	*Chem. Eng.*, **57**, 123–135 (Jan. 1950)
5011	Dybdal, E. C.	"Engineering and Economic Evaluation of Projects"	*Chem. Eng. Prog.*, **46**, 57–66 (Feb. 1950)
5012	Fagley, W. L., Blum, G. W.	"Calculate Payout Time for Your Investment"	*Chem. Eng.*, **57**, 116–8 (July 1950)

No.	AUTHOR	TITLE	REFERENCE
5013	Faith, W. L., Keyes, D. B., Clark, R. L.	"Industrial Chemicals"	Wiley, New York, 1950
5014	Grant, E. L.	"Principles of Engineering Economy"	3rd ed., Ronald Press, New York, 1950
5015	Happel, J., Aries, R. S.	"Venture Profitability in Economic Balances"	*Chem. Eng. Prog.*, **46**, 115–120 (Mar. 1950)
5016	Hertz, D. B.	"What Does Water Cost?"	*Chem. Ind.*, **66**, 512–4 (Apr. 1950)
5017	Hicks, T. G.	"Planning Refinery Heat Transfer Equipment"	*Petr. Refiner*, **29**, 97–101 (Sept.); 95–98 (Oct.); 113–5 (Nov. 1950)
5018	Kern, D. Q.	"A Cheaper Way to Buy a Plant—Know What You Need"	*Chem. Eng.*, **57**, 138–141 (July 1950)
5019	Knowlton, A. E.	"6th Steam Station Cost Survey"	*Elec. World*, **133**, 99–110 (Apr. 24, 1950)
5020	Koblins, W. D., Demarest, E. L.	"Waste Disposal—Cost Studies of Evaporation and Drying"	*Chem. Eng. Prog.*, **46**, 597–600 (Dec. 1950)
5021	LaLande, W. A.	"Successful Research Pays Off"	*Chem. Ind.*, **67**, 890–2, 904 (Dec. 1950)
5022	Lang, H. J.	"The Return on Investment"	*Mech. Eng.*, **72**, 890–4 (Nov. 1950)
5023	Molaison, H. J., Deckbar, E. A., Cook, N. C.	"Pilot Plant Equipment Costs"	*Chem. Eng.*, **57**, 110–1 (Apr. 1950)
5024	Monet, G. P.	"Cost of Ion Exchange"	*Chem. Eng.*, **57**, 106–7 (Mar. 1950)
5025	Nelson, W. L.	"Costimating, Discussion—Costs vs. Size"	*Oil Gas J.*, **49**, 263–4 (Oct. 5, 1950)
5026	Perry, J. H.	"Chemical Engineers' Handbook"	3rd ed., McGraw-Hill, New York, 1950
5027	Sherwood, P. W.	"Effect of Plant Process Size on Capital Cost"	*Oil Gas J.*, **48**, 81, 83–4, 95 (Mar. 9, 1950)
5028	Soule, R. P.	"Availability and Cost of Capital"	*Chem. Eng. News*, **28**, 1102–8 (Apr. 3, 1950)
5029	Thuesen, H. G.	"Engineering Economy"	Prentice-Hall, New York, 1950
5030	Tyler, C.	"Economics, Chemical"	Encyclopedia of Chemical Technology, Vol. 5, p. 446–465, Interscience, New York, 1950
5031	Zimmerman, O. T., Lavine, I.	"Chemical Engineering Costs"	Industrial Research Service, Dover, N. H., 1950

1951

5101	Anonymous	Editorial comment	*Chem. Eng. Costs Supplement*, **1** (Jan. 1951)
5102	Anonymous	"Process Power Requirements"	*Chem. Eng.*, **58**, 115 (Mar. 1951)
5103	Anonymous	"1950–51 Annual Report on Construction Costs"	*Eng. News-Record*, **146**, 117–167 (Mar. 29, 1951)
5104	Anonymous	"Estimating Requirements for Process Steam & Process Water"	*Chem. Eng.*, **58**, 110–1 (Apr. 1951)
5105	Anonymous	Editorial comment	*Chem. Eng. Costs Supplement*, **1** (Apr. 1951)
5106	Anonymous	"What Price Process Plants"	*Chem. Eng.*, **58**, 164–5 (May 1951)
5107	Anonymous	Editorial comment	*Chem. Eng. Costs Supplement*, **1** (July 1951)
5108	Anonymous	"Agglomeration"	*Chem. Eng.*, **58**, 161–174 (Oct. 1951)
5109	Anonymous	Editorial comment	*Chem. Eng. Costs Supplement*, **1** (Oct. 1951)
5110	Bean, T. W.	"Estimating Construction Costs in Chemical Process Industries"	*Ind. Eng. Chem.*, **43**, 2302–4 (Oct. 1951)
5111	Bechtel, V. R.	"Inflation in Production and Operating Costs"	*Ind. Eng. Chem.*, **43**, 2307–9 (Oct. 1951)
5112	Chilton, C. H.	"Process Labor Requirements"	*Chem. Eng.*, **58**, 151 (Feb. 1951)
5113	Chilton, C. H.	"Cost Estimating Simplified"	*Chem. Eng.*, **58**, 108–111 (June 1951)
5114	Clarke, L.	"Cost Estimates Answer Questions"	*Chem. Eng.*, **58**, 144–5, 150 (Dec. 1951)
5115	Cofield, E. P.	"Solvent Extraction of Oilseed"	*Chem. Eng.*, **58**, 127–140 (Jan. 1951)
5116	Degler, H. E.	"Cooling Towers and Air-Cooled Exchangers"	*Oil Gas J.*, **50**, 76–8, 80 (Sept. 6, 1951)
5117	Dickson, R. A.	"Piping Cost Estimation"	Chap. 10 of Littleton, C. T., "Industrial Piping, McGraw-Hill, New York, 1951
5118	Ferencz, P.	"Statistical Analysis of Cost Estimates"	*Chem. Eng. News*, **29**, 4158–4160 (Oct. 8, 1951); see correspondence, **30**, 501–2 (Feb. 11, 1952)
5119	Fleming, M. C.	"Thickeners and Clarifiers"	*Chem. Eng. Costs Supplement*, **1**, 53–58 (Oct. 1951
5120	Happel, J.	"New Approach to Payout Calculations"	*Chem. Eng.*, **58**, 146–8 (Oct. 1951)
5121	Jandrisevits, P.	"Preliminary Estimating by Selective Unit Costs"	*Ind. Eng. Chem.*, **43**, 2299–2301 (Oct. 1951)
5122	Kiddoo, G.	"Turnover Ratios Analyzed"	*Chem. Eng.*, **58**, 145, 148 (Oct. 1951)
5123	Lapple, C. E.	"Processes Use Many Collector Types"	*Chem. Eng.*, **58**, 144–151 (May 1951)
5124	Leonard, J. D.	"What Does Maintenance Cost?"	*Chem. Eng.*, **58**, 149–153 (Sept. 1951)
5125	Mavris, N. B.	"Economics of Increasing Capacity of Pipe-Line Systems"	*Oil Gas J.*, **50**, 118–121 (May 17, 1951)
5126	Minevitch, J. R., Knight, G. B., Root, S. E., Boraks, H. E.	"Chemica lPlant Construction Cost, Indoors vs. Outdoors"	*Chem. Eng. Prog.*, **47**, 385–390 (Aug. 1951)
5127	Newton, R. D., Aries, R. S.	"Break-Even Charts Without Fuss, Muss and Bother"	*Chem. Eng.*, **58**, 148–150 (Feb. 1951); (formulas incorrectly printed)
5128	Newton, R. D., Aries, R. S.	"Preliminary Estimation of Operating Costs"	*Ind. Eng. Chem.*, **43**, 2304–6 (Oct. 1951)
5129	Nichols, W. T.	"Next Time, A Precise Capital Cost Estimate"	*Chem. Eng.*, **58**, 248, 250 (June 1951)
5130	Nichols, W. T.	"Capital Cost Estimating"	*Ind. Eng. Chem.*, **43**, 2295–8 (Oct. 1951)
5131	Oberseider, J. L.	"Combustion Gas Turbine—Important New Prime Mover"	*Oil Gas J.*, **50**, 102, 104 (Aug. 9, 1951)
5132	Rodger, W. A., Fineman, P.	"Radioactive Waste Disposal"	*Chem. Eng.*, **58**, 146–150 (Dec. 1951)
5133	Sherman, R. A.	"Fuels"	Encyclopedia of Chemical Technology, Vol. 6, p. 896–901, Interscience, New York, 1951
5134	Stahl, R., Kasch, J. E.	"Chemical Engineering Economics—What It Holds for You"	*Chem. Eng.*, **58**, 270, 272, 274–6 (Feb. 1951)
5135	Steinbock, S. R.	"Before You Insulate"	*Chem. Eng.*, **58**, 173–4 (May 1951)
5136	Vaughn, T. H.	"How to Make Research Pay"	*Chem. Eng.*, **58**, 143–5 (Sept. 1951)
5137	Wells, A. J., Singer, S. A. G.	"Predesign Cost Estimates"	*Ind. Eng. Chem.*, **43**, 2309–2311 (Oct. 1951)
5138	Wellstead, R.	"Industrial Incinerators"	*Chem. Eng. Costs Supplement*, **1**, 14–15 (Jan. 1951)
5139	Wilson, R. P.	"Cost Estimating for Refineries"	*Petr. Eng.*, **23**, C39–40, 42 (Oct. 1951); same, abbreviated, *Oil Gas J.*, **50**, 116 (Oct. 11, 1951

1952

5201	Anonymous	Editoria comment	*Chem. Eng. Costs Quart.*, **2**, (Jan. 1952)
5202	Anonymous	Editorial comment	*Chem. Eng. Costs Quart*, **2**, (Apr. 1952)
5203	Anonymous	"Graphical Risk Factors"	*Chem. Eng.*, **59**, 249 (May 1952)
5204	Anonymous	Editorial comment	*Chem. Eng. Costs Quart.*, **2**, (July 1952)
5205	Bauman, H C.	"Economics of Power Factor Correction"	*Cons. Engr.*, **1**, 22–28 (Dec. 1952)
5206	Brown, C. O.	"Diesel Engine Power"	*Ind. Eng. Chem.*, **44**, 67A–70A (June 1952)
5207	Campbell, J. M.	"Design and Choice of Equipment for Gas Dehydration"	*Chem. Eng. Prog.*, **48**, 440 (Sept. 1952)

COST ESTIMATION INDEX . . .

No.	AUTHOR	TITLE	REFERENCE
5208...	Densler, R.	"Blower and Fan Costs"	*Chem. Eng.*, **59**, 130–4 (Oct. 1952)
5209...	Doyle, L. E.	"Analysis of Cost Estimating Principles & Practices"	*Tool Eng.*, **28**, 37–40 (May); 43–46 (June); **29**, 55–58 (July); 61–64 (Aug. 1952)
5210...	Ference, P.	"Statistics Can Put More Meaning into Your Cost Estimates"	*Chem. Eng.*, **59**, 143–7 (Apr. 1952); see correspondence, **59**, 254 (Oct. 1952)
5211...	Forbes, E. W.	"Portable Barking Equipment"	*J. Forest Products Res. Lab.*, 1952
5212...	Garner, L. W.	"Accounting for Factory Overhead Expenses in a Multiple-Use Plant"	*Ind. Eng. Chem.*, **44**, 2829–2833 (Dec. 1952)
5213...	Gerow, G. P.	"High Vacuum Equipment"	*Chem. Eng. Costs Quart.*, **2**, 80–89 (Oct. 1952)
5214...	Groggins, P. H.	"Unit Processes in Organic Synthesis"	4th ed., McGraw-Hill, New York, 1952
5215...	Guthmann, W. S. Inman, P. R.	"Cost Estimation in a Multipurpose Plant"	*Ind. Eng. Chem.*, **44**, 2832–3 (Dec. 1952)
5216...	Hoskins, R. J.	"'Entoleter' Impact Mill and Aspirator"	*Chem. Eng. Costs Quart.*, **2**, 100–2 (Oct. 1952)
5217...	Hutchins, T. V.	"Cubic Costing"	*Surveyor*, **3**, 11–12 (Feb. 2, 1952)
5218...	Ladd, H. O.	"Economics of Chemical Selling"	*Chem. Eng. News*, **30**, 4038–4041 (Nov. 24, 1952)
5219...	Lawton, F. L.	"Investment Costs for Use in Economic Comparison of Alternative Facilities"	*Elec. Eng.*, **71**, 691–6 (Aug. 1952)
5220...	Leonard, J. D.	"Work out a Maintenance Budget"	*Chem. Eng.*, **59**, 150–2 (Apr. 1952)
5221...	Mrachek, L. L.	"Estimating Data for Piping Labor Costs"	*TAPPI*, **35**, 34A, 38A (Oct. 1952)
5222...	Nelson, W. L.	"Replacement Value and Depreciation Rate"	*Oil Gas J.*, **51**, 111–2 (June 2, 1952)
5223...	Nelson, W. L.	"New Items to Appear in Quarterly Cost Indexes"	*Oil Gas J.*, **51**, 105 (July 7, 1952)
5224...	Nelson, W. L.	"What the Process Engineer Hopes to Find in the Accounting Records"	*Oil Gas J.*, **51**, 123, 125, 129, 131–2, 134, 136 (Aug. 25, 1952)
5225...	Plummer, F. L.	"Field-Erected Storage Tanks"	*Chem. Eng. Costs Quart.*, **2**, 53–67 (July 1952)
5226...	Roth, R. J.	"Break-Even Charts for the Chemical Process Industries"	*Chem. Eng. News*, **30**, 5437–5441 (Dec. 29, 1952)
5227...	Schwartzkopff, O.	"Efficiency Doesn't Always Pay"	*Chem. Eng.*, **59**, 140–1 (Aug. 1952)
5228...	Schweyer, H. E.	"Capital Ratios Analyzed"	*Chem. Eng.*, **59**, 164 (Jan. 1952)
5229...	Schweyer, H. E.	"Compound Interest Charts Speed Engineering Economics Studies"	*Chem. Eng.*, **59**, 206–7 (June 1952)
5230...	Sherwood, P. W.	"How to Prepare Preliminary Cost Evaluation Reports"	*Petr. Refiner*, **31**, 126–130 (June 1952)
5231...	Skinner, C. C. Batchelder, H. R., Katell, S.	"Comparative Cost Study of Ammonia Plants"	*Ind. Eng. Chem.*, **44**, 2381–5 (Oct. 1952)
5232...	Skinner, E. M.	"Cost Accounting in Refinery Operating Control"	*Oil Gas J.*, **50**, 117–8, 120, 122, 124 (Apr. 7, 1952)
5233...	Smith, J. C.	"Cost and Performance of Centrifugals"	*Chem. Eng.*, **59**, 140–2, 147 (Apr. 1952)
5234...	Swift, L. L.	"Mechanical Gas Producers"	*Chem. Eng. Costs Quart.*, **2**, 10–14 (Jan. 1952)
5235...	Van Eck, F. M.	"Venture Capital: Risk vs. Opportunity"	*Chem. Eng.*, **59**, 192–4 (Feb. 1952)
5236...	Weiss, J. M.	"Chemical Plant Expansion"	*Chem. Eng. News*, **30**, 2382–3 (June 9, 1952)
5237...	Wessel, H. E.	"New Graph Correlates Operating Labor Data for Chemical Processes"	*Chem. Eng.*, **59**, 209–210 (July 1952)
5238...	Yaseen, L. C.	"Plant Location"	Business Reports, Inc., New York, 1952
5239...	Zimmerman, O. T. Lavine, I.	"Haveg Equipment"	*Chem. Eng. Costs Quart.*, **2**, 89–100 (Oct. 1952)

1953

5301...	Anjanos, P.	"Direct Data Cuts Estimating Time 66 Per Cent"	*Am. Mach.*, **97**, 172–7 (Mar. 16, 1953)
5302...	Anonymous	"Process Equipment Costs Are Becoming Stabilized"	*Chem. Eng.*, **60**, 220–1 (Mar. 1953)
5303...	Anonymous	Editorial comment	*Chem. Eng. Costs Quart.*, **3**, (Apr. 1953)
5304...	Anonymous	"Gas Engines Make Cheap Power"	*Chem. Eng.*, **60**, 118 (July 1953)
5305...	Anonymous	"Cost of Recording, Controlling and Indicating Instruments"	*TAPPI*, **36**, 24A, 26A, 28A (July 1953)
5306...	Anonymous	"1953 Annual Report on Construction Costs"	*Eng. News-Record*, **148**, 79–181 (Oct. 8, 1953)
5307...	Anonymous	"Gas Turbines"	*Petr. Refiner*, **32**, 120 (Dec. 1953)
5308...	Beattie, R. D. Vivian, J. E.	"When Making Cost Estimates, Watch Your Language"	*Chem. Eng.*, **60**, 172–5 (Jan. 1953)
5309...	Bell, J. E.	"What Price Spares in a Refinery?"	*Oil Gas J.*, **51**, 244, 247–8 (Mar. 23, 1953)
5310...	Boberg, I. E. Fickett, W. R.	"Relative Costs of Alternate Types of Reactor Vessel Construction"	*Petr. Proc.*, **8**, 690–2 (May 1953); *Oil Gas J.*, **52**, 107 (Aug. 3); 161 (Aug. 17); 145 (Aug. 24, 1953)
5311...	Bond, W. W.	"Preparing Preliminary Job Estimates"	*Oil Gas J.*, **52**, 106–7, 127, 129 (Dec. 14, 1953); (Figs. 1 and 8 reversed in printing)
5312...	Bottomley, H.	"How to Prepare Cost Estimates"	*Petr. Refiner*, **32**, 211–4 (Sept. 1953)
5313...	Bottomley, H.	"Definitive Cost Estimating"	*Petr. Refiner*, **32**, 110–2 (Oct. 1953)
5314...	Braca, R. M. Happel, J.	"New Cost Data Bring Economic Pipe Sizing Up to Date"	*Chem. Eng.*, **60**, 180–7 (Jan. 1953)
5315...	Bragg, L. B.	"Stedman Packed Columns"	*Chem. Eng. Costs Quart.*, **3**, 84–90 (July 1953)
5316...	Bridges, F. L.	"Platecoil Heat Transfer Units"	*Chem. Eng. Costs Quart.*, **3**, 65–74 (July 1953)
5317...	Campbell, J. M., Laurence, L. L.	"Dehydration of Natural Gas and Light Hydrocarbon Liquids"	*Petr. Refiner*, **31**, 65 (Aug.); 106 (Oct.); 109 (Nov. 1952); 138 (Jan.); 131 (Feb.); 151 (Mar. 1953)
5318...	Cleveland, R.	"Simple Approach to Cost Estimating"	*Product Eng.*, **24**, 178–181 (July 1953)
5319...	Cottrell, C. E.	"More on Estimation of Vessel Costs"	*Chem. Eng.*, **60**, 143 (Feb. 1953)
5320...	Cramer, G. W.	"Goulds Stainless Steel Centrifugal Pumps"	*Chem. Eng. Costs Quart.*, **3**, 117–122 (Oct. 1953)
5321...	Dallavalle, J. M.	"Dust Collector Costs"	*Chem Eng.*, **60**, 177–183 (Nov. 1953)
5322...	Downs, G. F. Tait, G. R.	"Selecting Pipe-Line Diameter For Minimum Investment"	*Oil Gas J.*, **52**, 210–4, 319 (Nov. 16, 1953)
5323...	Dyson, G. M.	"Cost Control in the Chemical Industry, I—Costing Principles and Methods"	*Mfg. Chemist*, **24**, 231–5 (June 1953)
5324...	Dyson, G. M.	"Cost Control in the Chemical Industry, II—Costing, Oncosts and the 'Break-Even' Diagram"	*Mfg. Chemist*, **24**, 419–423 (Oct. 1953)
5325...	El-dib, I. A., Huntington, R. L.	"Economics of Reducing Crude-Oil Vaporization Losses"	*Oil Gas J.*, **51**, 90–94 (Mar. 9, 1953)
5326...	Fearnside, T. A., Cheney, F. C.	"Fast Estimate for Power Plant Costs"	*Chem. Eng.*, **60**, 239–241 (June 1953)
5327...	Gilmore, J. F.	"Short-Cut Estimating of Processes"	*Petr. Refiner*, **32**, 97–101 (Oct. 1953)
5328...	Grover, A. E.	"How to Control Shop Costs"	*Am. Machinist*, **97**, 147–162 (Mar. 16, 1953)
5329...	Hamilton, J. P.	"Economic Analysis in Petroleum Refining"	*Petr. Refiner*, **32**, 102–6, 109 (Oct. 1953)
5330...	Hartogenais, A. M.	"Depreciation, Deterioration and Obsolescence"	U. S. Dept. of Commerce, Management Aids for Small Business, No. 34 (Aug. 1953)
5331...	Harvey, C. C.	"Economic Factors of Atmospheric Corrosion vs. Protection"	*Petr. Refiner*, **32**, 122 (June 1953)
5332...	Horn, A. B., Sergeys, F. J., Strader, W. C.	"Economic Analysis in Chemical Plants"	*Petr. Refiner*, **32**, 107–9 (Oct. 1953)
5333...	Hull, L. W.	"Pick a Vacuum System for Your Job"	*Chem. Eng.*, **60**, 200–2 (Nov. 1953)
5334...	Kennedy, W. J. Stueve, C. C.	"Sizing Crude-Oil Pipe Lines"	*Oil Gas J.*, **52**, 133–4, 168, 264 (Sept. 21, 1953)

No.	AUTHOR	TITLE	REFERENCE
5335...	Kilgren, E. W., Miller, C. S.	"A Short Cut to Gasoline and Cycling-Plant Costs"	*Oil Gas J.*, **51**, 144–152, 201 (Apr. 27, 1953)
5336...	Kistin, H. R., Cameron, C. S., Carter, A. P.	"Where Do Construction Dollars Go?"	*Chem. Eng.*, **60**, 191–5 (Nov. 1953)
5337...	Krystow, P. E.	"How to Evaluate Economy of Construction Materials"	*Chem. Eng.*, **60**, 204 (Jan. 1953)
5338...	La Pointe, J. R.	"Freight Costs for Equipment Shown by Nomograph"	*Chem. Eng.*, **60**, 213 (Apr. 1953)
5339...	Lewis, G. E.	"Your Guide to Mixer Costs"	*Chem Eng.*, **60**, 191–4 (Jan. 1953)
5340...	Lindsey, E.	"Evaporation"	*Chem. Eng.*, **60**, 227–240 (Apr. 1953)
5341...	Lynn, L., McKlreen, J. R.	"Simplify Your Cost Estimates by Nomographs"	*Chem. Eng.*, **60**, 193–5 (Apr. 1953)
5342...	Mayer, K. M.	"Operate for Maximum Profit"	*Chem. Eng.*, **60**, 214–6 (Sept. 1953)
5343...	Mayo, H. C.	"Electric Motors vs. Steam Turbines"	*Petr. Refiner*, **32**, 96–100 (Aug. 1953)
5344...	Michell, A. M.	"Shell and Tube Heat Exchangers"	*Chem. Eng. Costs Quart.*, **3**, 38–52 (Apr. 1953)
5345...	Montross, C. F.	"Entrainment Separation"	*Chem. Eng.*, **60**, 213–236 (Oct. 1953)
5346...	Nelson, W. L., Buthod, A. P.	"Petroleum (Refinery Processes)"	Encyclopedia of Chemical Technology, Vol. 10, p. 157–161, Interscience, New York, 1953
5347...	Nelson, W. L.	"Cost of Coking Plants"	*Oil Gas J.*, **51**, 141 (Jan. 19, 1953)
5348...	Nelson, W. L.	"Stainless Steels in Petroleum Refining—Oxidation Resistance"	*Oil Gas J.*, **51**, 99 (Feb. 2, 1953)
5349...	Nelson, W. L.	"Ocean Transportation—Coal and Oil"	*Oil Gas J.*, **51**, 137 (Feb. 9, 1953)
5350...	Nelson, W. L.	"Estimate of Price Changes of Alloy Steel"	*Oil Gas J.*, **51**, 126 (Mar. 9, 1953)
5351...	Nelson, W. L.	"Feasibility of Using Chromium and Chromium-Nickel Steels"	*Oil Gas J.*, **51**, 267 (May 25, 1953)
5352...	Nelson, W. L.	"Cost of Handling and Firing Coal or Fuel Oil"	*Oil Gas J.*, **52**, 265 (May 25); 118 (June 1); 141 (June 8, 1953)
5353...	Nelson, W. L.	"Prices of Alloys and Plastics"	*Oi lGas J.*, **52**, 327 (June 22, 1953)
5354...	Nelson, W. L.	"Cost of Shipping Very Viscous Materials"	*Oil Gas J.*, **52**, 108 (June 29, 1953)
5355...	Nelson, W. L.	"Applications of Stainless Steel"	*Oil Gas J.*, **52**, 156 (Aug. 17, 1953)
5356...	Nelson, W. L.	"Cost of Tanker Transportation"	*Oil Gas J.*, **52**, 113–7 (Sept. 7, 1953)
5357...	Nelson, W. L.	"Pipe-Line Transportation Rates"	*Oil Gas J.*, **52**, 351 (Sept. 21, 1953)
5358...	Nelson, W. L.	"What Price Complete Refinery Installation"	*Oil Gas J.*, **52**, 117 (Nov. 23, 1953)
5359...	O'Donnell, J. P.	"New Correlation of Engineering & Other Indirect Project Costs"	*Chem. Eng.*, **60**, 188–190 (Jan 1953); see correspondence, **60**, 156, 158 (Apr. 1953)
5360...	Osborn, R. J.	"How to Select Motors & Controls"	*Oil Gas J.*, **52**, 111–6 (Dec. 14, 1953)
5361...	Pierce, D. E.	"How to Control Costs by Kilowatts"	*Chem. Eng.*, **60**, 195–7 (Jan. 1953)
5362...	Plummer, F. L.	"New Cost Data—Field-Erected Storage Tanks"	*TAPPI*, **36**, 14A, 16A, 18A, 20A, 22A, 24A (July 1953)
5363...	Puerifoy, R. L.	"Estimating Construction Costs"	McGraw-Hill, New York, 1953
5364...	Rase, H. F.	"Take Another Look at Economic Pipe Sizing"	*Petr. Refiner*, **32**, 141–3 (Aug. 1953)
5365...	Reynolds, S. C.	"Entrainment Eliminators Save Money"	*Petr. Refiner*, **32**, 138 (July 1953)
5366...	Rhea, T. R., Quill, J. S.	"Gas Turbines and Centrifugal Compressors—Application to Natural-Gas Pipe Lines"	*Oil Gas J.*, **51**, 133 (Feb. 9, 1953)
5367...	Riegel, E. R.	"Chemical Process Machinery"	2nd ed., Reinhold, New York, 1953
5368...	Rubin, F. L.	"Heat Exchanger Costs Today"	*Chem. Eng.*, **60**, 201–6 (May); 177–181 (July), 229–233 (Sept.); 196–202 (Oct. 1953)
5369...	Schuette, W. A.	"Breakeven Charts; They'll Tell You If a Product Should be Made"	*Product Eng.*, **24**, 170–1 (Aug. 1953)
5370...	Schweyer, H. E.	"Cost Estimation for Process Operations"	*Chem. Eng. News*, **31**, 3266–3270 (Aug. 10, 1953)
5371...	Schweyer, H. E.	"How Inventory Costs Affect Your Process Economics"	*Chem. Eng.*, **60**, 188–192 (Oct. 1953)
5372...	Smith, S. P.	"If You Ship Process Products"	*Chem. Eng.*, **60**, 222–5 (Mar. 1953)
5373...	Sommers, H. A.	"Manufacture and Distribution of Carbon Dioxide"	*Chem. Eng. Prog.*, **49**, 333–9 (July 1953)
5374...	Steele, S.	"An Engineer's View of the Dollar"	*Chem. Eng.*, **60**, 157–161 (Feb. 1953)
5375...	Streicher, L., Bowers, A. E., Briggs, R. E.	"Demineralisation of Water by Electrolytic and Ion Exchange Processes"	*Ind. Eng. Chem.*, **45**, 2394–2401 (Nov. 1953)
5376...	Tallman, J. C.	"Ejectors Show Low First Cost"	*Chem. Eng.*, **60**, 176–9 (Jan. 1953); see comment **60**, 158 (Mar. 1953)
5377...	Tighe, F. C.	"Railroad Freight Rates on Chemicals"	*Chem. Eng. News*, **31**, 752–6 (Feb. 23, 1953)
5378...	Tighe, F. C.	"Highway Motor Carrier Rates on Chemicals"	*Chem. Eng. News*, **31**, 3538–3543 (Aug. 31, 1953)
5379...	Tighe, F. C.	"Water Transport Rates on Chemicals"	*Chem. Eng. News*, **31**, 4916–4920 (Nov. 23, 1953)
5380...	Tyler, C.	"Where Cost Estimates Go Sour"	*Chem. Eng.*, **60**, 198–200 (Jan. 1953)
5381...	Uhl, V. W.	"Heating Units for Molten Salt Heat-Transfer Media"	*Chem. Eng. Costs Quart.*, **3**, 111–7 (Oct. 1953)
5382...	Uncles, R. F., Carter, T. L.	"Watch Those Hidden Packaging Costs"	*Chem. Eng.*, **60**, 185–8 (Aug. 1953)
5383...	Vosnick, H. P.	"Cast Iron Process Vessels"	*Chem. Eng. Costs Quart.*, **3**, 97–111 (Oct. 1953)
5384...	Weaver, T.	"What Acetylene Costs"	*Petr. Refiner*, **32**, 151–6 (May 1953); also *Chem. Eng. Prog.*, **49**, 35–39 (Jan. 1953)
5385...	Weiss, J. M.	"How to Make Phenol"	*Oil Gas J.*, **51**, 146–155 (Feb. 23, 1953)
5386...	Wessel, H. E.	"How to Estimate Costs in a Hurry"	*Chem. Eng.*, **60**, 168–171, 200 (Jan. 1953)
5387...	Whalen, J. M.	"When and Where to Use Air-Cooled Heat Exchangers"	*Petr. Proc.*, **8**, 1528–1531 (Oct. 1953)
5388...	White, R. E.	"Refrigeration"	Encyclopedia of Chemical Technology, Vol. 11, p. 645, Interscience, New York, 1953
5389...	Williams, G. C.	"Report on Evaporator Costs"	*Chem. Eng.*, **60**, 156 (Apr. 1953)
5390...	Williams, R.	"What to Do With That Old Plant?"	*Chem. Eng.*, **60**, 185–6 (Dec. 1953)
5391...	Wilson, W. B.	"How to Plan Power Distribution"	*Chem. Eng.*, **60**, 199–203 (Apr. 1953)
5392...	Wilson, W. B.	"Should Your Plant Produce Power?"	*Chem. Eng.*, **60**, 235–8 (Mar. 1953)
5393...	Woods, B. M., DeGarmo, E. P.	"Introduction to Engineering Economy"	MacMillan, New York, 1953
5394...	Zimmerman, O. T., Lavine, I.	"Adsorptive Dryers"	*Chem. Eng. Costs Quart.*, **3**, 9–18 (Jan. 1953)
5395...	Zimmerman, O. T., Lavine, I.	"Inert Gas Generators"	*Chem. Eng. Costs Quart.*, **3**, 18–21 (Jan. 1953)
5396...	Zimmerman, O. T., Lavine, I.	"Pfaudler Glass-Lined Equipment"	*Chem. Eng. Costs Quart.*, **3**, 21–30 (Jan. 1953)
5397...	Zimmerman, O. T., Lavine, I.	"Propeller Type Agitators"	*Chem. Eng. Costs Quart.*, **3**, 74–82 (July 1953)
5398...	Zimmerman, O. T., Lavine, I.	"Mixing Tanks"	*Chem. Eng. Costs Quart.*, **3**, 83 (July 1953)

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WHY YOU MUST . . . Coordinate Your

The Usual Approach and What's Wrong With It

MOST insidious of all the faults with the conventional approach to material handling is:

• High Costs Stay Hidden

During the thirties, we paid common labor 40 to 50 c. per hr. for stevedoring, unloading and loading common carriers, trucking to and from the warehouse and moving material from operation to operation. Compared with the costs of raw material and the investment in buildings and process machinery, this item was insignificant, and accounting buried it with the rest of "Indirect." At that time, the few pieces of power equipment that could reduce the manpower requirements were crude and so expensive that their use was not economical.

Trend of management thinking in those days was toward better production tools, more production per operating manhour spent. A major effort affecting our entire industrial picture moved in this direction. Since there were no critical labor shortages, it was a case of more and more production from a given machine or process.

But Pearl Harbor touched off a new industrial revolution. During the forties and since, wages for such labor have risen three and four-fold. Rates of $1.20 to $2 per hr. are now taken for granted. On a national scale, we spend over 25% of our industrial payroll just moving things. No dollar value is added to the product, but last year we spent $15 billion.

In spite of this, very few companies today recognize material handling as a major function in their organization. They do not realize that their accounting procedure does not reflect the true cost of moving material through the plant. The accountant actually works for the tax collector, and it is still the practice to lump jobs requiring common labor into "Indirect" along with oilers, sweepers, janitors, etc. Many so-called direct labor or production jobs contain high percentages of material-handling time that is traditionally part of the job and is buried in the direct operating costs.

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• Too Late

A second fault with the usual approach is the lack of early attention to material handling in the planning of a new plant.

In planning the process at the laboratory stage, chemists are naturally more interested in reactions, control and yield than in the seemingly simple problem of moving raw materials into and through the apparatus.

When the pilot plant is built, too many arrangements of equipment are enlarged images of the original laboratory apparatus. Because it is a pilot plant, the main idea is to get sample production out with a minimum of attention to the manpower required to handle the material.

As sales of the new product increase, management decides to go all out and build a production plant costing several million dollars.

The required tonnage of the various raw materials is carefully computed on the flow chart; kettle, pipeline and pump sizes are studied for best performance. But the raw material receiving, storage and movement through process gets one of two treatments:

• Too Much

In the first case, the engineer goes all out for an elaborate maze of conveyors, elevators and storage hoppers—complete with electric controls and interlocks, all push-button operated.

The operating cost in terms of manpower will be low. Such an investment should only be made when volume is high and continuous. An intermittent operation having considerable down time during each year should be equipped with a minimum of automation lest the high investment to be amortized force the unit cost of the product too high to be competitive.

There are too many plants operating today that suffer from high equipment costs. Strangely enough, complete conveyorization does not always produce the lowest operating cost.

There are several other ways to move material that are more flexible, less costly to buy and operate and which require little or no more manpower than the conveyor man's dream.

• Too Little

The other extreme develops about as follows. When the process equipment is purchased and installed, the major items are carefully reviewed with the designers and builders. But at this point, our engineer discovers that there may be some items that require physical movement between operations at least, and probably somebody will be needed to ship the finished product. Being aggressive, he decides to solve his own material-handling problem.

He consults the classified directory and discovers a picture of a hand truck in one of the advertisements that looks like it might do the job. Hand trucks are cheap and easily maintained; no need to buy any high-priced power equipment for a laborer's job.

When the plant goes into production, the owners and operating personnel soon discover that their operating costs are higher than they had first anticipated; that there seems to be too much congestion at certain points in the process flow; and that in spite of a sizable receiving - shipping - warehouse crew, there are numerous delays waiting for materials, holdups in process, and somehow things aren't shipped on time. Their work-in-process inventory is much higher and as a result, their cash position is weaker. Labor turnover is high, and they soon learn how much it really costs to hire and train.

While our engineer did a creditable job with the process, he overlooked the important thing which infests every operation from receiving platform to process to shipping: the need of coordinated material handling.

Material Handling

By A. K. STRONG

The Coordinated Approach and What's Right With It

You may not realize that the basic problem of material handling involves everyone in the organization from the board chairman down. This means that:

• It's Tied In

What is needed is a realistic, coordinated approach to material handling involving accounting, methods, production, design engineering, production control, quality control, safety, sales, purchasing, traffic and labor relations.

Ideally material handling should be coordinated at the "dream-up" stage; before actual drawings are made. If we approach any process or operation layout with the material handling point of view, we will greatly improve our chances of building a low-cost operating unit.

But if our plant is already built and in operation, the first change to be installed will require accounting to isolate handling costs—starting at the receiving dock, into and out of raw material storage, into and through process, including piece work or so-called "direct" operations, warehousing and shipping.

Unless this change in accounting procedure is initiated by top management, there will be many objections and arguments by the accounting group opposing any change. One company's auditor told me that any change of this sort would render past cost figures useless. He insisted that the executives of the company have received their operating statements in a certain form for many years. They understood these and any change would be a calamity.

We had not asked that the final reports be changed. All we wanted was a breakdown at the department and plant level isolating the handling costs.

When the auditor was convinced that the final dollar figures would be the same, he went along. Once the major areas of handling expense are determined, management can begin taking corrective steps.

In addition, they will have a basis for cost comparison when improvements are installed. Production, production control and quality control will now come under scrutiny; and required changes in layout, methods and process will become more and more obvious. As improvements are developed, the engineering group will assist in remodeling and design.

The safety engineer must be consulted to insure compliance with safety regulations. Usually, the newer methods are safer and less hazardous than the old, and he will welcome the resulting drop in the accident rate.

The personnel director will be directly involved because as changes in the status quo are made, diplomatic treatment of personnel changes assume primary importance.

The maintenance and millwright groups will be called upon to alter existing equipment, add new devices here and there, and probably they will acquire some new equipment to install and maintain. If the plant does not have a good preventive maintenance program, the newly acquired material-handling equipment will be an excellent place to start.

• It Uses Specialists

Material handling engineers take nothing for granted, but continually ask "Why do we do it that way?" "Is there a better way?" "Can we eliminate this or that step?" In many cases, they have eliminated many steps and move huge quantities of material through a maze of intricate operations almost automatically. These are the logical men to help the management of your company solve their handling problems.

First of all, the material handling engineer will insist that material handling be made a function of management. The material-handling man in your company should be placed high enough up the ladder to be effective in every branch of the company. He should report to a vice president at least.

He will then be in a position to coordinate the work of accounting, production and control, engineering, safety and personnel in an over-all program designed to fit the needs of the company.

Because of his specialized knowledge of the various types of available equipment, he can advise management as to the best solutions to the problems that the new cost picture indicates.

He will investigate the possibility of using unit loads or of bulk shipments into your plant from the supplier. This will bring him into contact with purchasing and traffic.

Many a good handling man has come to grief at this point because he either lacked the proper management stature, or his position within the company was below the level of these two time-honored functions, and they refused to cooperate on the grounds that his ideas were too revolutionary and unsound.

I have seen executives in both these departments refuse to act on a material-handling man's suggestion because they felt that they alone held the divine right to suggest changes.

Do not misunderstand this line of reasoning. The material-handling man never successfully "commands" anything. He must win cooperation by doing a good job and selling his services and his ideas. He will be more effective if his position on the organization ladder commands respect from other department heads.

As improvements are made, eventually the problem of unitized or bulk-load shipments to customers will appear. Here again, he will require the full cooperation of the traffic department as he changes from the historical methods of shipping to today's standards.

His contacts with the customer should be with the wholehearted cooperation of sales. At first, they will resist the idea, but after a few successful shipments have been completed, and the customer registers satisfaction

with the resulting savings, he will need to place a restraining hand, lest they promise the customer everything in unit load form, regardless of the customer's ability to handle it.

To apply the ideas I have discussed in any company will depend upon many factors.

If it is a single plant operation and the total labor force comparatively small, as in some chemical units, a consultant would be advisable. If the operation is larger, involving many workers and operations with a considerable amount of movement of material, regardless of weight, then you may find it to your advantage to employ a material-handling man on a full-time basis.

You should be prepared to pay up to five figures for a good man; if you can find him. If you can't, then call in the consultant that will help you train your own.

It is not advisable to treat material handling on a "one-shot" basis, because, like many serum injections used to prevent disease, the effect is not permanent. Plant conditions and products will change. This will require further study and analysis by a trained material-handling man.

• It Is Organized

One type of organization deals with a single plant company in which the plant engineer who happens to have a flair for material handling is responsible for all material handling within the plant, for process improvement, and for new and improved plant layouts.

Whenever any new equipment or process is contemplated, the plant engineer has an opportunity to study the problem and make his recommendations. In many cases he is given a free hand to select the method and the equipment to be used. He, of course, must collaborate with the operating heads involved to insure complete agreement. Once this agreement is reached, the equipment or change is ordered and installed. It is the duty of the plant engineer to follow all phases of this installation including putting the unit into production.

Another responsibility is the supervision of all "in plant" handling which includes an equipment pool of fork lifts, trailers, cranes, bulldozers, etc., by which receiving, shipping and general yard work and "in plant" movement is accomplished. In this operating spot, he must render satisfactory "handling" service to all departments. A fair amount of diplomacy is necessary to maintain good interdepartmental relations.

This man reports to the vice president in charge of manufacturing. But while this position gives him stature, it does not permit him to throw his weight around. He must cooperate with his fellow workers and "sell" each new idea.

Unlike with many plant engineers, the duties of maintenance, light, heat and power are supervised by others reporting to the chief engineer.

Another type of organization involves multiple plants wholly owned by one company and controlled from a central office.

In this case, each plant unit, being of considerable size, has within its staff organization a material handling engineer. He is responsible to the plant manager and functions as an integral part of the local plant organization.

In the main executive offices we find a material handling coordinator, reporting to a vice president. The duties of the coordinator are at policy level. He aids management in policy matters and conveys such decisions to the plants, consulting with their material handling engineers on general company-wide problems and assisting them wherever so requested. Such a position requires broad experience and tact in the field of human engineering as well as that of material handling.

The third type of organization is found in a company such as American Cyanamid. Here the parent company owns and operates many small and medium-sized plants. They also control several divisions which in turn operate one or more plants. The larger divisions are self-sufficient to a degree, having their own engineering, methods and time study, as well as one or more men covering material-handling.

In addition, there are wholly owned subsidiaries also completely equipped with the usual engineering services.

One such subsidiary, Chemical Construction Corp., not only designs and builds process and plant facilities for other chemical companies throughout the world, but also contains specialist services such as corrosion, heat and power plant, electrical, air conditioning, process development and material handling, which are available to all company units.

The services of the material handling group are available upon request to all plants, divisions and subsidiaries.

Our work encompasses all material movement:

1. From the raw source, be it mine, quarry or vendor plant.
2. Into and through the process.
3. Between processes or plant units.
4. Into the final shipping package, be it carboy, drum or bulk container.
5. To the customer's plant.

For example, we are currently working with our purchasing group, assisting our suppliers in making unit load shipments to our various plants.

We conduct over-all plant surveys to determine needed areas of improvement in both process and in-plant handling.

We are constantly working on in-plant handling problems involving movement of raw materials, supplies and chemicals in process.

Several studies are now underway involving the movement of products which we term "intermediates" between one plant and another. Such studies are with the cooperation of our traffic and related departments.

In the area of shipping packages, we design and install complete bagging, drum off and carboy filling units as well as units for smaller items such as pharmaceuticals.

Last but not least, we are under constant pressure from customers and sales for better, lower cost unit loads of our many products.

Unless the total yearly operating cost of a division such as ours is offset by savings and services accruing a profit to the company, we are of no value to that company.

Material handling is not an intangible. The $15 billion that American industry spent last year in moving its product around was cold, hard cash. The development of techniques and the proper application of power equipment necessary to reduce that figure require tact, some ingenuity, some more tact and plenty of good, hard work. Just remember, the impossible takes a little longer.

You will need the answers to these questions and at least 20 more . . .

- **Without our own computer, can we farm computing out?**
- **Which will be worth most to *us*—farm out, or buy or rent a computer?**
- **What costs are involved, and what about obsolescence?**
- **Digital or analog—which type will best fit our own problems?**
- **If a digital machine, what size, type, speed and capacity?**
- **Must all work be handled by mathematicians and electronics experts?**
- **How big a staff will be needed, and how shall we come by it?**
- **What can computers do, other than compute?**
- **We hear computers can simulate, follow and control processes. True?**
- **And what about computers in data reduction and in finding information?**

. . . before you can know whether your company can . . .

Save Time, Money, With Computers

The familiar "Slow—Men at Work" no longer applies when mechanical and electronic computation takes over—as it is now beginning to do in progressive engineering offices. Here's how computers fit in.

ASCHER OPLER

It is a reasonable assumption that before too long, if not already, your company will have to face up to the question of whether its technical work will, or will not, be aided by the use of modern computers. Therefore, we shall consider some of the questions that you or others of your management will have to ask—and answer—before you can decide intelligently.

Because your greatest use will probably be for digital computers, rather than the analog type,* this article will deal almost entirely with the digital machine; and because you will probably be concerned only with the small and intermediate size machines, we shall ignore the large, spectacular computers which have created so much interest and admiration in the popular press. While the relatively few big ones are going their spectacular way, smaller machines by the thousands are producing mountains of useful results every day. For example, as visitors enter one major installation to be shown through a nearly completed major computer, they thread their way through a battery of desk-sized punched-card "accounting machines." Most of these visitors would be amazed to learn that these far-from-spectacular "small" machines have been working day and night for years solving difficult problems in physics, engineering, astronomy and statistics.

Punched-card machines like these are found in the accounting departments of nearly every major industrial firm, university and government installation. They are one of the two types we are going to discuss. The other—the stored-program, magnetic drum computer—is relatively new, but more than a dozen commercial models will soon be on the market.

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*A digital computer gives results in definite numbers, and an analog computer in terms of position of some sort of measuring element, or as a magnitude of a quantity such as pressure, voltage or speed.—*Editor.*

1. What organizations use computers?

Judging from published reports, the organizations which use these smaller

Table I—Organizations Using Digital Computers for Chemical and Chemical Engineering Problems*

Arthur D. Little, Inc., Cambridge, Mass.
Atlantic Refining Co., Philadelphia, Pa.
California Institute of Technology, Pasadena, Calif.
California Research Corp., Richmond, Calif.
Columbia University, New York, N. Y.
Dow Chemical Co., Midland, Mich. and Pittsburg, Calif.
General Electric Co., Schenectady, N. Y.
Humble Oil Co., Baytown, Texas
M. W. Kellogg Co., Jersey City, N. J.
Magnolia Petroleum Co., Dallas, Texas
Massachusetts Institute of Technology, Cambridge, Mass.
Michigan State College, East Lansing, Mich.
Ohio State University, Columbus, Ohio
Pennsylvania State College, State College, Pa.
Socony-Vacuum Oil Co., Paulsboro, N. J.
Standard Oil Development Co., Linden, N. J.
The Texas Co., Beacon, N. Y.
University of California, Berkeley, Calif.
University of Illinois, Urbana, Ill.
University of Wisconsin, Madison, Wis.
U. S. Atomic Energy Commission (has computers at several locations)
U. S. Bureau of Mines, Pittsburgh, Pa.
U. S. National Bureau of Standards, Washington, D.C.

*Partial list based on reports in the literature.

Table II—Partial List of Firms Offering Computing Service

Electronics Div., Nat'l Cash Register Co., Hawthorne, Calif.
Eng. Res. Associates Div., Remington Rand, St. Paul, Minn.
International Business Machines Corp., New York, N. Y.
Mathematical Computing Service, Bayside, N. Y.
Raytheon Manufacturing Co., Waltham, Mass.
Remington Rand, Inc., New York, N. Y.
Telecomputing Corp., Burbank, Calif.

Table III—Partial List of Makers of Digital Computers

Burroughs Corp., Philadelphia, Pa.
*Eckert-Mauchly Computer Div., Remington Rand, Inc., Phila., Pa.
Electro-Data Corp., Pasadena, Calif.
Electronic Computer Div., Underwood Corp., New York, N. Y.
Electronics Div., Nat'l Cash Register Co., Hawthorne, Calif.
*Eng. Res. Associates Div., Remington Rand, St. Paul, Minn.
Ferranti Electric, Inc., New York, N. Y.
Hogan Laboratories, Inc., New York, N. Y.
International Business Machines Corp., New York, N. Y.
Jacobs Instrument Co., Bethesda, Md.
Laboratory for Electronics, Inc., Boston, Mass.
Logistics Research Corp., Redondo Beach, Calif.
Marchant Research Corp., Emeryville, Calif.
Monroe Calculating Machine Co., Orange, N. J.
Remington Rand, Inc., New York, N. Y.

*Primarily makers of large machines.

computers constitute the major employers of technical manpower—government, university, and industrial research and development organizations of various kinds.

Among them are a number of large chemical firms, several universities, certain government projects, and nearly every major petroleum company. Table I lists some of the organizations whose staff members have published reports on computer applications.

2. Are there contract computing organizations?

A number of organizations which have computing machines will undertake calculations for you on a contract basis. The manufacturers of the computing machines often establish computing sections to take problems on contract. Their rates are reasonable, because they feel that in so doing they gain from the experience of solving typical customer problems. There are, in addition, several firms which have purchased or rented computers for the primary purpose of supplying mathematical services to others. Furthermore, a number of universities and research institutes will handle certain computational problems on a consulting basis. Table II lists some of the organizations which will perform computation on a service basis.

How to Get Computing Done

3. Should we farm out computing, or buy or rent our own equipment?

This depends upon several factors, the most important of which is the quantity of computing work that you will require. For example, if only an occasional problem calls for computation, you would certainly be better off if you sent this problem out to be computed. If you are certain that you will have a large number of problems to calculate, you will probably be wiser to install your own machine. Perhaps sending problems out for solutions may lead to the decision to install your own equipment.

There are two plans in operation for acquiring small computers for your own use. One may buy the machines outright, or rent them from their manufacturer. The rental plan has proven most popular for punched-card machines. The principal reasons are (1) the large capital allocation required for purchase and (2) the rapid obsolescence of the equipment. Experience has shown, unfortunately, that the rate of obsolescence in the computer field is so high a machine may well be obsolete before its cost has been amortized. The rental of punched-card machines implies the right to discontinue or replace any particular machine that has become obsolete. The rental plans usually include service provisions, so that manufacturer's representatives will maintain the equipment in good working order. However, if one purchases a punched-card machine, this plan is also available on an annual service contract basis. Purchase is the usual arrangement for the magnetic-drum machines. The purchase price of these machines varies between $60,000 and $140,000. A partial list of manufacturers of small and intermediate digital computing machines appears in Table III.

4. Can we share use of our machine with our accounting department?

In certain special cases, such an arrangement is possible. Where an accounting department is fully equipped and has slack periods, computing problems may be interspersed with the accounting ones. This arrangement may last only if the engineering organization has only occasional problems. For continued use of machines, it is pref-

erable to organize a separate technical computing department, though joint operation may be the ultimate arrangement for small organizations.

An arrangement with an accounting department sometimes is an excellent way to get started. It is frequently necessary to prove to management that computing machines can effect substantial savings in engineering costs. In order to justify the time and expense of setting up the machines in the first place, some concrete evidence of benefit must be established. Many people have done this by running sample problems through the accounting department machines. At present, all or nearly all accounting computers are of punched-card type. Engineers who share machines with the accountants are therefore restricted to this type of equipment. However, in the future we may see the use of magnetic-drum computers for accounting purposes, a matter which is under extensive investigation at present.

Cost and Obsolescence

5. What costs are involved?

The cost of "instructing" and running a computing installation involves (1) the cost of acquiring and maintaining the equipment, and (2) the staffing of the installation. This answer deals only with the first of these. The rental price of typical punched-card computing machines runs from $300 to over $2,000 per month depending on speed, storage capacity, and flexibility. In using punched-card computers, a collection of auxiliary machines is required. These will raise the rental between $500 and $1,000 per month above that quoted for the computing machine proper. In addition, there is considerable overhead expense for supplies, files, and the like.

6. What about obsolescence?

This is a very practical question. Nobody has yet built a machine that is not obsolete in some respect by the time it reaches completion. This comes as the result of the tremendously rapid growth and development in the computer field. Though new ideas for machine improvement are coming forth constantly, this should not deter one from acquiring a computing machine. Many machines, although regarded obsolete, are completely adequate for the solution of all problems handled by a large engineering organization. The important point is that the machine should fit the job requirements.

One way to avoid obsolescence is by using a rental plan. Note that replacing two year old "obsolescent" computers with new ones will entail a considerably increased expense. The old one may serve you for years to come. Replacement should be made only after a detailed analysis of the improvements that will result, such as labor and time saved, or the new problem solutions that will become possible.

7. How does cost compare with desk computers?

There are many intangibles entering into this. If computing machines are correctly used, they will be able to do the work that is normally handled by 10 to 50 people using desk computers. However, one shouldn't jump to the conclusion that if the cost per hour is the same for a computing machine as for a man at a desk computer, then the computing machine will be 1/10 to 1/50 as expensive. The computing machine requires a number of people to program, maintain, and operate it.

What Kind of Computer?

8. Digital or analog?

We have already decided to limit this article to digital computers but it is worthwhile here to pause a minute and see what reasons we might have for choosing an analog computer.

Which type is preferred is an old argument, with merit on both sides. Each of these types, digital and analog, has its place. Probably a judicious combination of the two would be ideal. Thus far, all analog computers that have been built have been more or less special purpose machines, while most automatic digital computers are general purpose machines. Analog computers have been built for the solution of simultaneous equations, for the solution of ordinary differential equations, for finding the roots of polynomials, and for the solution of highly specific, repetitive problems. Where a computer has been designed to handle a specific problem, it will usually be fastest and most efficient. Where a variety of problems is encountered, general purpose computers are highly desirable. The digital method will give more accurate results although this is not necessarily an advantage, since many engineering calculations require only two to three digit accuracy.

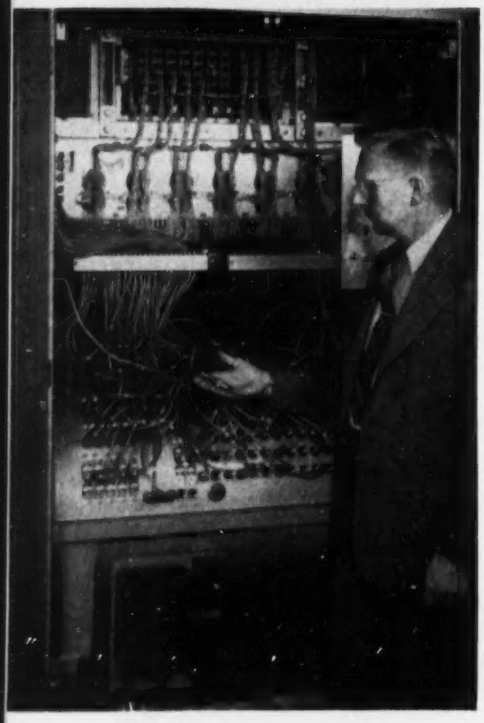
If one's problem consists largely of differential equations, one should seriously consider acquiring one of the new all-electronic differential analyzers. There are several of these on the market. These are both inexpensive and highly efficient for the solution of one or more differential equations. These computers can handle a limited number of non-linearities and analytical or empirical functions. Solutions are frequently faster and simpler to program on these machines than by digital computer. An important advantage of analog computers is the ability to observe the effect of twisting knobs (variation of input parameters) on the ultimate solution. For several years, analog devices were preferred for the routine solutions of high order simultaneous linear equations, but digital computers have gradually replaced them for this application.

9. How much speed and capacity do we need?

This is one of the most important decisions you will have to make. The storage capacity ("memory") of a machine is measured by the number of "words" (commands or single numbers of fixed length) that may be stored. This capacity ranges from 12 on a punched-card relay machine to about 4,000 on a magnetic-drum computer. Although a large memory is highly desirable, there are punched-card techniques available which permit one to obviate the use of large storage units. However, where it is possible to obtain machines with a large memory, this facilitates the handling of complex problems.

The mechanical requirements of





Magnetic drums are now taking over the "remembering" job for various intermediate size computers. At the top is one type of magnetic memory used by IBM. Below it is the drum used in the Remington Rand special computer on p. 206.

feeding punched cards in and out of machines confines their rate to slower than 2½ cards per sec. Usually one operation or short sequence is performed as each card passes through the machine. Magnetic-drum machines are almost invariably limited in their speed by the time required to deliver a word from storage to the arithmetical part of the machine. As a consequence, the average speed is 20-40 calculations per sec. This is still approximately 10 times faster than the fastest electronic punched-card computing machine, and probably up to 1,000 times faster than the slowest mechanical punched-card calculating machines.

Just as it is desirable to have as large a memory as possible in the machine, so it is also good to have the highest possible speed commensurate with allowable cost. Both of these factors would make a magnetic-drum computer seem vastly more desirable than the punched-card machines. Since punched-card machines have been used for computational work for nearly 25 years, it will be interesting to see whether or not they are displaced by the magnetic-drum machines. The supporters of the punched-card machines point out that there are many desirable features (separability, reproducibility, etc.) which compensate for increased speed and capacity of the magnetic-drum machines.

10. Where do punched-card machines stand today?

While many people predict that the end is in sight for punched-card machines, I think it is a little too early to count them out. The rate at which the cards can be fed into and out of the machine appears to be a severe limitation for really high-speed computing. Not long ago there was a distinct tendency to drop punched cards in connection with newer-type intermediate computers. However, that trend appears to be reversing today. Magnetic-drum computers are being equipped now with optional punched-card input and output, and several of the newest moderate-speed computers have been announced featuring punched-card input and output.

Two of the reasons why punched-cards will continue to be used are (1) their separability and (2) their simplicity for actuating printing devices. Separability refers to the attribute of a deck of punched cards that makes it easy to rearrange the sequence, to remove or add one or more cards, or to make a correction on a single card and then restore it to its place in the deck. Making additions, deletions or modifications is one of the advantages of punched cards. Secondly, a read-out device featuring paper tape or magnetic tape is generally limited to reading one spot on the tape at a time, and translating this to numbers or letters. However, if punched card output is used, the 80 or 90 columns on the card may be printed simultaneously with the rugged tabulating machines used for many years in accounting work.

As an example, the IBM 407 printing machine will print at the rate of 300 characters a second. Furthermore, this printing will be in ink on paper, making as many as five carbon copies. The printed characters include numbers, letters, and punctuation marks or symbols. Again, compared to the usual speed of output produced by paper tape or magnetic tape feeding into an electric typewriter, it is easy to see the preference for the punched-card machines. To counter these arguments, the tape proponents point out that it is possible to program a computer to receive a small group of corrections or additions to a sequence of instructions on tape, and to have the computer revise the main tape, adding the new instructions and making necessary corrections and deletions.

There is considerable effort underway to develop faster devices for reading out information from a computer. At present, all proposed devices seem expensive, and many lack the ability to type hard copy (directly readable copy on paper stock).

Sorting of large masses of information is a task that is frequently and readily performed by punched-card machines. If punched-card machines are to go, then we must be able to perform the equivalent operation on a magnetic-drum computer. There are several procedures available for rearranging the several thousand pieces of randomly scattered information. To convert from serial number to some different arrangement is a complex and lengthy procedure. In general, to rearrange n items each stored in ran-

dom order in a single memory unit requires $n^2/2$ operations on a typical magnetic-drum computer. Where $n = 10{,}000$ this takes 50,000,000 steps. For comparison, a simple sorting machine will handle this problem at speeds as high as 12.5 min. per digit to be sequenced.

11. What about the new intermediate machines?

They are a very attractive buy for a technical computing installation. The magnetic-drum memory is exceptionally useful, and the number and variety of available programs permits the calculation of a wide range of problems. For many engineering problems, these machines should be completely satisfactory. Their chief drawbacks are the slow speed of input and output, and in very long problems, the actual computation speed and the access time to the magnetic memory. Since the information in a magnetized spot on the drum may be read out only when it passes the reading head, the maximum access time will be approximately the time for one revolution of the drum. The mean access time for random storage will be one-half of this time. (See Fig. 1.) It is quite possible to make a considerable saving here by using what is known as minimum-access coding. This requires a little more skill in planning the storage location of the various factors in the calculation.

12. Would one of the really big machines help us?

The way the big machines differ from the small punched-card machines and the intermediate magnetic-drum machines is primarily in speed and capacity. The basic speed (the time to perform an addition, subtraction, multiplication, or division) is usually about 100 times faster than it is for the magnetic -drum machines, and thousands of times faster than it is for the punched-card machines. These large machines usually have a high-speed memory—storage units which may use either mercury columns or cathode ray tubes and are able to deliver their contents from storage to the computer in a matter of microseconds, rather than milliseconds). The basic computing circuits may also be faster, and consequently, the entire calculation will be completed at an extremely rapid rate.



Card programmed calculators such as the IBM machine shown here have been used for several years by both commercial and engineering organizations.

Such a machine will have several types of storage and usually will contain, in addition to the high-speed storage, a group of magnetic drums or magnetic-tape memory devices. In using these, the magnetic memory serves as the back-up for the high-speed memory, and the operation of reading out a block of information from a tape or drum to a high-speed memory device is quite standard. It is not uncommon to store 100,000 ten-digit words in such a magnetic memory device.

The big machines are particularly useful for the rapid solution of partial differential equations and high order matrices and similar problems. However, the cost will run close to $1 million (or the equivalent of that in monthly rental). If one computes the hourly rate of rental for such a machine, it is very high but due to its speed, the cost per calculation is low. Judged by the charges for hourly use

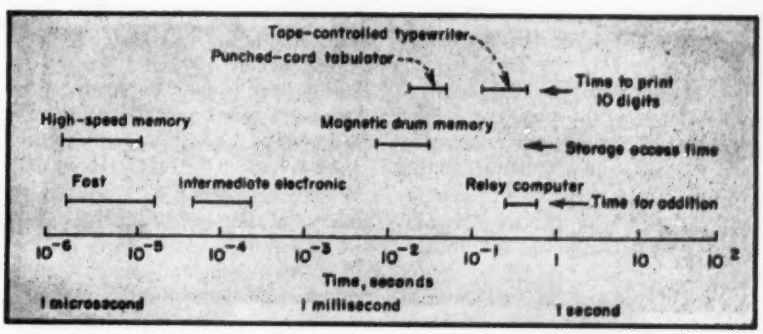


Fig. 1—Time for addition, storage access and print-out for various devices.



Among the really big computers is Remington Rand's Univac which stores data on magnetic tape as well as in other "memories." The tape alone is equivalent in capacity to 18,000 punched cards.

of such machines on a service basis, this runs approximately $300 per hour. In order to utilize such a machine effectively, one must have either a continual series of problems of enormous magnitude that will keep the machine busy or, one must have a large variety of smaller problems and a small platoon of coders, programmers, and mathematicians.

This combination of costs is a real detriment to effective utilization of the big machines by any except the largest organizations. In connection with effective utilization, a suggestion has been made that only a few of these machines are needed in centralized locations, and that individual installations should have input and output devices to a central computing machine arranged for remote control operation. One such operation has been carried out for some time. The Wayne University computing group in Detroit has been operating the Burroughs computer in Philadelphia in just such a manner. This may be an interesting trend to watch in the future.

How Machines Are Operated

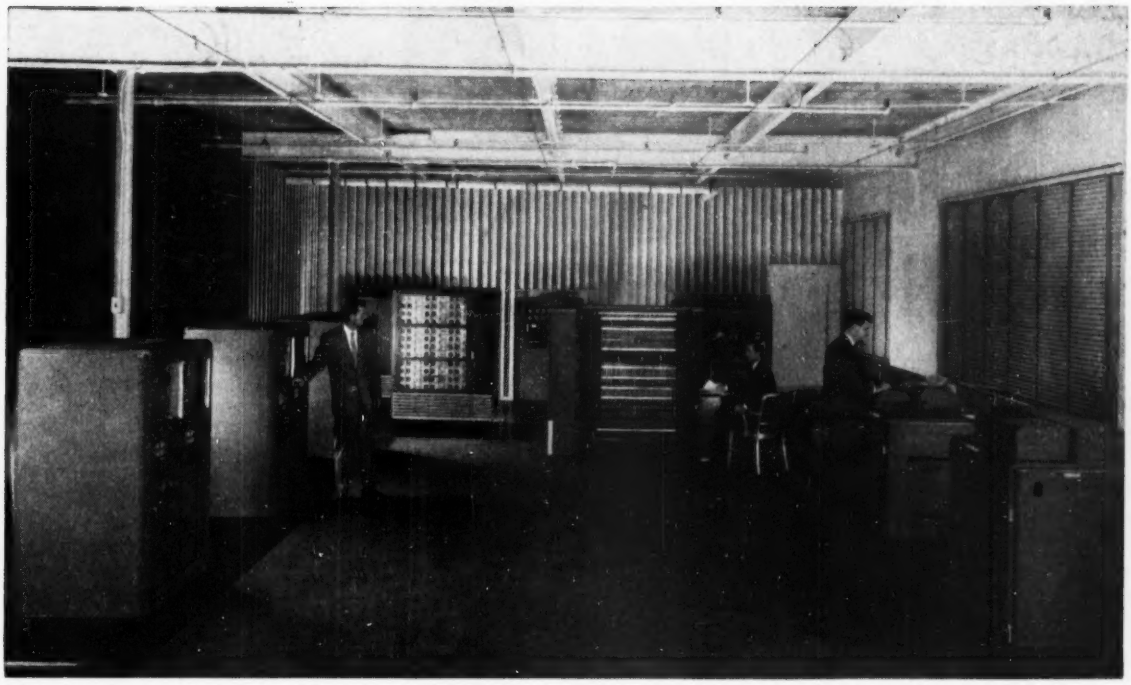
13. How does one instruct (program) these machines?

There are three general methods of programming the smaller machines: (1) wire-program, (2) card-program, and (3) stored-program. By programming we mean the planning of the sequence of instructions which the computing machines must carry out.

The crudest type, wire-programming, is used with the simplest machines, and is carried out by connecting wires, or "patch-cords" between a number of terminals in a switchboard or control panel. The number of contacts will frequently run into the thousands. Considering the large number of possible interconnections, one has a tremendous versatility here. The wiring techniques that have been developed for punched-card computers have been adequate for many large classes of practical problems and have been used in many ingenious arrangements.

Card-programming is rather a misnomer, since wire-programming is used to devise a control panel which is then modified by instructions punched on a card. As each card enters the machine, the coded number operates relays which switch the wiring arrangements to carry out the operation indicated by the code. A typical card-programming set-up involves the use of the "three-address" code. That is, the storage location of two factors *A* and *B* are given, then the instruction to be performed, and finally, the location *C*, in which the machine is to place the result. As each card passes through the machine, each successive operation in a sequence is performed. There must be a one-to-one correspondence between one card and one operational step.

A stored-program machine works on a somewhat different principle. The entire program is fed into the machine. The individual instructions are stored in memory units, in exactly the same way that numbers are. When the "start" button is pushed, the first instruction is taken from storage unit No. 1, carried out, then the next is taken from storage unit No. 2, and so forth. The program has provisions for conditional skipping and repetition of indicated programs; in this way, the original program may be modified. Because of this "selective sequence" feature, loops of repeated programs may be established and thousands of operations carried out where only a few commands are written.



IBM's big computers include the 701 electronic data processing machine shown here, designed especially for engineering use. Its storage is by way of magnetic tape and drums, and electrostatic tubes.

14. How does one translate a problem to a suitable machine program?

Such a translation requires a sequence of steps that varies slightly from problem to problem, but generally goes like this: (1) Decide on the most suitable equations to use for this particular problem and the ranges of the parameters to evaluate. Remember that no solution can be better than the assumptions in the equations and the approximations in the numerical parameters. (2) Translate the equations into a form that is suitable for calculating using only addition, subtraction, multiplication, division, special functions, logical instructions, and so on.

In many problems no modification will be necessary, but for others the mathematical basis will have to be changed. For example, in a digital machine all integrations must be changed to some form of summation.

With the equations broken down to a sequence of simple steps and with a knowledge of the specific instruction rules for your computing machine, (3) translate these steps into a series of ordered commands. (4) Inspect the range of parameters to see what the largest and smallest numbers will be that will occur in the course of the calculation. Make provision that these numbers will not be lost due to either overflow (number too large for machine capacity) or because the numbers become too small to be treated as significant. In the same step the digital error occurring in the final results should be estimated and this should be discussed with the originator of the problem.

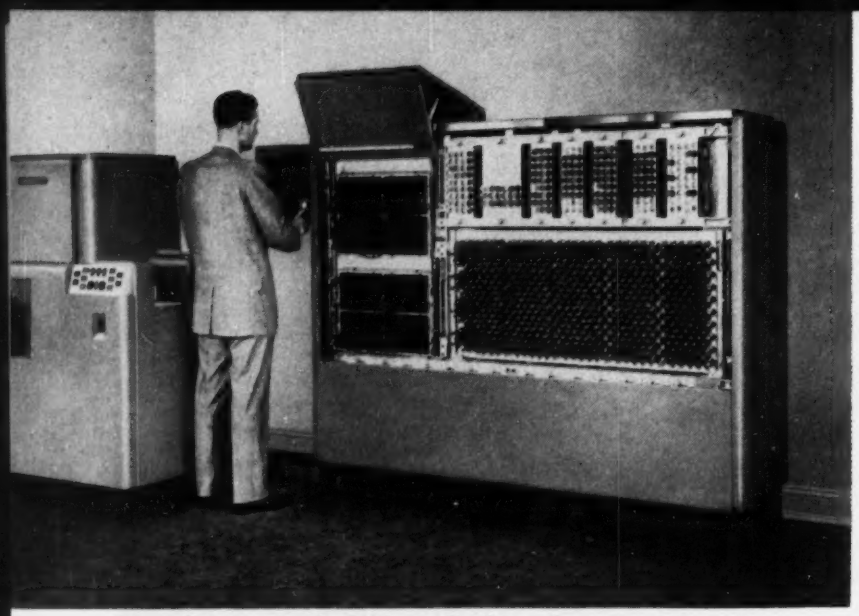
Now (5) the program is punched on cards or on perforated tape. (6) A trial run using a single hand-calculated result is passed through the computing machine. The results of this trial run are compared with the correct results. If agreement is reached, the program is carried out. If disagreement results, a trouble-shooting procedure must be used to locate the exact source of error in the program. (7) After the computation is completed it should be checked to see that the results are mathematically equivalent to the desired solution before returning them to the originator.

How About Personnel?

15. Must all work be handled by mathematicians and electronics experts?

Commercially manufactured equipment needs no electronics experts on the operating staff. The manufacturers supply maintenance personnel who will keep the equipment in good running order, either on a contract basis, or as a feature of the rental agreement. The actual operation of the machines requires only a modest amount of skill. Since this involves primarily loading tapes or cards into the machines, operating various controls, and removing the results, training can be accomplished in a short time. Perhaps the most important qualification for an operator is the ability to recognize various machine signals of faulty operation or incorrect results.

The greatest personnel need will be for people who are qualified in programming. This is the process of translating the problems of a technical staff to a series of sequenced addition, subtraction, multiplication, division, and logical steps on the computing machine. While it is necessary that the senior programmers have a good mathematical background, it is not necessary to employ professional mathematicians for this purpose. Nevertheless, the number of professional mathematicians now employed



Intermediate computer by Remington Rand is card-programmed Type 409.

by process industries has increased sharply.

A good programmer should understand the physical significance of the problem. His is a translator's job, for he must know two languages. One is mathematics and computational methods, the other, the technical background of his employer's business. It is not significant which language is learned first, but facility comes faster if he understands the technical problems and then becomes interested in computing.

Using some of the simplified programming methods available, it is possible to have the engineers program their own problems directly. This has worked out well in a number of locations. Such self-service computing requires that the engineer formulate his problem mathematically and have a good understanding of the simplified coding method. Engineers with no machine experience have successfully coded problems after only two or three hours study of the method.

16. Should we train our own or hire experienced men?

Hiring experienced men will be difficult since there are very few available, and only a handful of schools offer this training. Furthermore, it is relatively simple to train your own people for this type of work. Specific training in programming a given machine is usually made available by the manufacturer of the machine. There are regular "schools" run at periodic intervals by the various computer manufacturers. Furthermore, the manuals on the technique of programming supplied by most manufacturers are exceptionally clear, and it is not too difficult to learn programming from these manuals. Several of our universities are now giving courses in programming as shown in Table IV.

17. How large a staff to keep a machine busy?

Assuming one-shift operation, one operator and one person who either punches cards or prepares tapes will be required. The number of men who prepare programs will vary with the ability of the machine and the complexity of the programs. In many cases one man can do the job satisfactorily; in others, two or three will be required. You can probably count on a minimum of four persons working full time in a computing installation. For a two- or three-shift operation, more operators and tape or card punchers will be needed but probably not additional programmers. Two-shift and three-shift operation is most desirable where long repetitive problems are to be calculated which require little help from the programming personnel. Experience has shown that shift operation of programmers is not too efficient.

Table IV—Partial List of Educational Institutions Offering Training in Computer Programming and Techniques

Brown University, Providence, R. I.
California Institute of Technology, Pasadena, Calif.
Columbia University, New York, N. Y.
Cornell University, Ithaca, N. Y.
Georgia Institute of Technology, Atlanta, Ga.
Massachusetts Institute of Technology, Cambridge, Mass.
New York University, New York, N. Y.
Ohio State University, Columbus, Ohio
Pennsylvania State College, State College, Pa.
Purdue University, Lafayette, Ind.
San Jose State College, San Jose, Calif.
Stanford University, Stanford, Calif.
Trinity College, Hartford, Conn.
University of California, Berkeley, Calif.
University of California at Los Angeles, Los Angeles, Calif.
University of Florida, Gainesville, Fla.
University of Illinois, Urbana, Ill.
University of Michigan, Ann Arbor, Mich.
University of Pennsylvania, Philadelphia, Pa.
University of Wisconsin, Madison, Wis.
Washington State College, Pullman, Wash.
Wayne University, Detroit, Mich.

18. Can the computer companies provide training?

Very definitely. In addition to the regular training courses mentioned previously, the companies will generally be glad to give special instructions to your personnel at the time of installation of your machine. Many companies provide technical advisory service. The technical men who do this work travel freely and will be glad to spend time with you setting up your installation. After a while you will be able to stand on your own feet nicely.

What Can Computers Do?

19. Do we need "colossal" problems to use a computing machine?

Definitely not. While it is satisfying to have machines work on problems of staggering complexity, most work is done on comparatively modest problems. Examples of such simple problems are (1) the calculation of useful tables such as the weight capacity of cylindrical tanks of various radii and lengths when filled with fluids of various densities, (2) statistical calculations yielding the mean and standard deviation of large number of production and research data, (3) least squares fitting, (4) solution of simple algebraic and transcendental equations, (5) solution of small sets

of simultaneous equations, (6) integrations, and (7) simple problems involving functions and interpolations. On the other hand, one may set up to solve only a single problem. The finding of the roots of a 10th degree polynomial or the solution of 30 simultaneous equations are examples of single problems that might be programmed. The time spent in programming and coding must be considered along with the solution time and the number of problems of the type that are foreseen.

20. What sorts of chemical engineering problems have been solved?

An extensive review by Rose, Heiny, Johnson and Schilk (see Ref. 1) showed that problems from almost every branch of chemical engineering have been adapted to computing machines. Two symposiums on this subject have already been held: one at the 1951 Boston meeting of the American Chemical Society, and another at the December 1953 meeting of the American Institute of Chemical Engineers in St. Louis. Problems in heat transfer, adsorption, distillation, reactor design, process control, thermodynamics, vapor-liquid equilibrium, diffusion, engineering statistics, and ion exchange performance are but a few that come readily to mind.

21. Are there problems we can solve only with computers?

In the strict sense, the answer to this question is no. Since computing machines can only add, subtract, multiply, divide, and make logical decisions, all of these operations may be performed by men using desk computers and proper instructions.

However, practically speaking, we do use computing machines for tasks that would probably never be given to human operators. These problems fall into several categories. The first of these are problems whose solution turns out to be too time consuming to run through. These operations are, for example, the solution of high-order simultaneous equations, and especially the solution of partial differential equations.

A second type of problem that would not normally be done by hand is that of repetitive calculation with extensive variation of parameters. For example, one might calculate the performance of a distillation column consisting of 35 plates in which the operating parameters vary in each calculation. By selecting a dozen different sets of conditions, one might determine the optimum method of operating such a column. This requires repetitive plate-by-plate calculations for each reflux ratio.

Another type of question not normally handled is that employing simulation of a process with a mathematical model. This would be an exceedingly tedious type of calculation involving many thousands and thousands of steps in hand calculation. Furthermore, if probability factors are used, as in the Monte Carlo method, this will necessitate consulting either a table of random numbers or perhaps a roulette wheel between each step and the calculation. It is in this type of work that computing machines excel.

22. Are there problems too difficult for present-day machines?

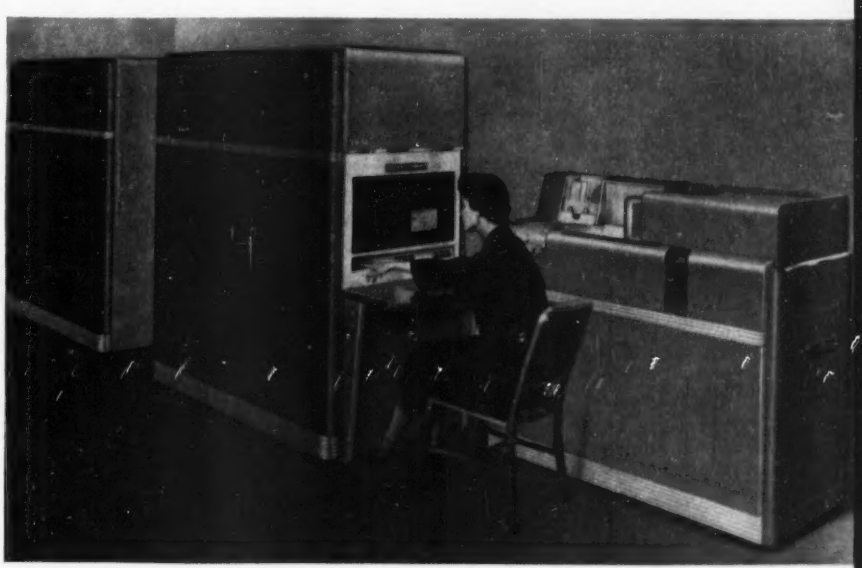
Two classes of these problems can be visualized. First there are problems that appear impossible to break down into a sequence of logical and arithmatical operations. The second type are problems that can be programmed in this manner, but with requirements for storage and computing time that are too high. Examples of the first type include certain sorts of nonlinear differential equations and some sets of simultaneous nonlinear algebraic and transcendental equations. The second class includes the solution of large sets of linear simultaneous equations —for example, a thousand—and the solution of three-dimensional, time-dependent partial differential equations over a large and irregular volume.

23. What can computers do besides calculate?

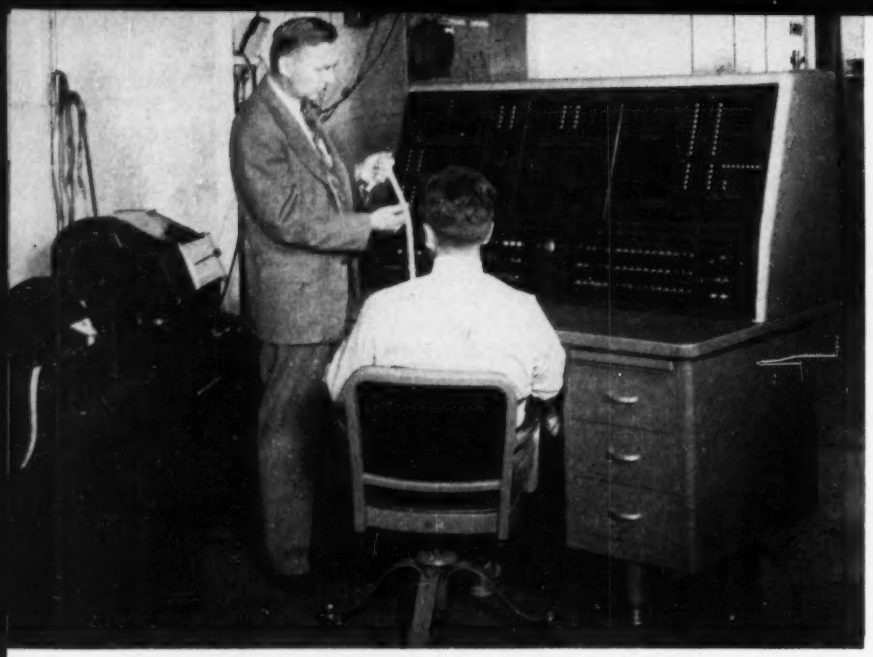
This is an interesting field and one that is being actively explored. In addition to solving numerical equations, the machine can (1) simulate processes, (2) follow and—to a certain extent—control processes, (3) reduce large masses of data, (4) work out problems in logic, (5) search for and retrieve information "buried" in large masses of material, (6) solve problems in the theory of games, (7) handle empirical data, carry out Monte Carlo calculations, and many other unconventional applications.

24. How can computers simulate processes?

For some time, analog computing machines have been used to simulate physical processes. The various elements may be connected in such a way that their behavior represents the behavior of the physical system under study. Then instead of obtaining



Magnetic drum memory is a feature of IBM's intermediate machine, Type 650.



One remarkable example of special-purpose computers is Rem-Rand's machine built for CAA to handle airway traffic information, control flights, supply weather data.

numerical solutions to specified problems, one merely operates the simulated system in each of the modes under study and observes the simulated behavior.

The use of digital computers for simulation is less well known. The type of simulation that is performed on a digital computer is that of actually carrying out each incremental step and process for each instant of time and each instant of space involved. This may be adapted to heat transfer problems, mass flow problems, and combinations of these. As an example, in some work with ion exchange column performance, the computing machines "carry out" the exchange in each incremental section of the column at each instant of time. The operation in a sense can be considered "bookkeeping," and the complete function time-space relationship calculated. From these, the performance could be reconstructed for the column as a whole.

25. How can computers follow and control processes?

This is one of the newer and more exciting developments in the computing machine field. Before answering this as it applies to digital computers, we should review the performance of a typical instrument that follows and controls processes. Take, for example, a thermocouple connected to an electronic potentiometer-type recorder equipped with a controller which feeds back and regulates the temperature of a process. If you will analyze the recorder-controller you will see that it receives a signal from the temperature of the process and adjusts the heat control valve. In doing this, it observes the rate and duration of deviation, calculates the required correction and performs the proper valve adjustment. Note that central to this system is an "analog computer" in the recorder that consists of a network of resistances to "calculate" the measured temperature, and a pneumatic controller to "compute" the necessary corrections.

This type of system works very well where the function to be displayed and controlled is a simple one. However, as modern process development leads to a greater compexity, a point is reached where no combination of simple elements will be able to compute the function to be recorded, displayed, and controlled. An example might be the control of a process monitored by a continuous mass spectrometer. A set of simultaneous equations must be solved after each set of instrument readings. This is where digital computers come in, as in Fig. 2.

The difficulties in such a method become apparent at once. Firstly, the information to the computer must be supplied in a discrete digital form, whereas the output of the thermocouple appears as a continuously varying voltage. Secondly, the output of the computer is in digital form and we would like to display this in continuous graphical form and make continuous corrective movements. Thirdly, the cost of installing a digital computer for every thermocouple recorder in, for example, a large petroleum refinery, would be fantastically high.

However, these problems are not very serious ones. There are a large number of devices on the market for converting from continuous to digital, or the reverse. Furthermore, installation of a large number of computers in numerous locations in a plant is unnecessary because of the high speed of the computing machines. One suitable computing machine centrally located can do all the computation required by a large plant employing hundreds of recorders and controllers. The results can be telemetered back to the actual control site. For digital control of processes, there is less information available. Note that valve controls, for example, work on a two-valued logic. That is, they are either open the correct amount or not and if not they should be either closed or opened. These particular choices may be governed by purely digital information in the form of yes-no answers in the output of a computing machine. But, so far as I know, there is not yet any commercial equipment on the market for such control purposes.

26. What is data reduction?

The log book of a pilot plant, a well-kept detailed laboratory notebook, a recorder chart showing a week's run of a reactor and indicating the temperature at numerous points, all present staggering problems if we seek to arrive at a few simple truths from such masses of data. The problem is one of data reduction, meaning application of statistics, curve fitting, recalculation under different coordinates, etc., to arrive at a simple curve, equation, or perhaps simply a yes-or-no answer. This is the exact opposite of the method of setting up a model by assuming a set of equations hold and then solving them. In data reduction we make large numbers of observations and try to find simple generalizations about them. Needless to say, this type of calculation is admirably suited for automatic computing machines.

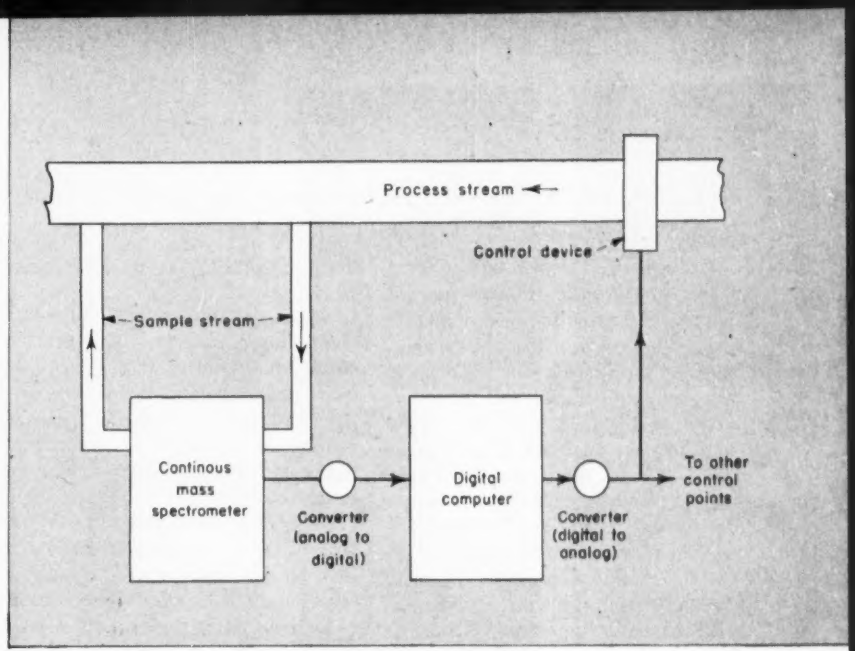


Fig. 2—Someday computers will control processes. Most probably a single computer will be used to tie together numerous instruments and their controllers.

27. What is meant by logical problems?

A form of symbolic logic called Boolean algebra has been known for nearly a hundred years. This logic, which reduces statements to simple combinations of algebraic letters and symbols, has been extremely useful in the development of computing machine circuits and telephone circuits. Whenever we deal with a problem in which a large number of alternatives is present, each contingent upon the selection of a previous alternative, symbolic logic can help unravel the end effect of a single choice at the beginning. In dealing with a complex electrical or piping problem in conjunction with a large chemical processing unit there are times when such methods will help.

Various techniques have been developed in which one feeds into the computing machine all of the logical statements describing the entire system, then asks if so and so is true (or on), what will be the final effect at point P—true (on) or false (off)?

28. How can computers retrieve buried information?

Your librarian, your patent group, or your organic chemists—for example—continually face problems that involve searching large masses of information. The present rapid rate at which information is being accumulated is causing concern and much attention is being given to methods of automatic retrieval of information. Among the methods considered is the use of digital computing machines. In this method, one stores on punched cards, magnetic tape, or a magnetic drum the coded information. This might be, for example, patents arranged by number, inventor, classification, and content. Assuming all the information wanted is stored, if one asks the machine for the number of a patent issued to a certain individual on a specified subject but before 1945, the machine will promptly locate and print the number of all such patents. This is a subject that is being actively pursued and we can expect to see interesting progress in a few years.

29. How can computers help by "playing games"?

This is rather a big question. Boiled down, modern game theory describes games or, more generally, competitive situations in which strategic decisions can play a large part in the final outcome. J. Von Neumann has shown how to formalize a competitive situation between two "players" in the form of a payoff matrix. These payoff matrices are usually matrices of inequalities—rather than the familiar equality matrices—with the inequalities implying that each player is subject to opposion or restriction.

This is the key to the use in chemical engineering problems. Whenever a system describes the operations of an interrelated group of processes under restriction (throughput capacity, raw materials shortage, government restrictions) then game theory or a modified version of it can assist. What we seek to do is to place a value (dollars, yield, or other desirable quantity) on the overall process and to maximize this process in the face of restrictions by the judicious choice (strategic decision) of operating conditions. While this problem is by no means completely solved using computing machines, there are a number of techniques available which will assist greatly toward maximizing the value of a restricted system. The difficulty of gathering the required data will often be nearly insurmountable.

30. How can a machine handle empirical data in practical problems?

There are several methods available for using empirical functions in computing problems. One may use tables of these functions stored in the computing machine, or the function to an empirical equation. For example, in dealing with distillation or flash equilibrium problems, the K values at each pressure and temperature for each of the components may be stored on magnetic tape or drum or on punched cards. The second approach to this, reduction to empirical equations, would substitute for the tables empirical equations such as those of Antoine or Benedict. To refine the process, the computing machine itself can be used to reduce the tables to the most accurate and simplest empirical equation. If an empirical equation is not practical, sometimes a series can be found whose expansion will supply the desired empirical function. These techniques hold for the well known mathematical functions such as the trigonometric, exponential, hyperbolic and Bessel functions, powers, roots, and so on.

REFERENCES

Rose, A., Heiny, R. L., Johnson, R. C., and Schilk, J. A., *Ind. Eng. Chem.*, **46**, 916 (1954). (A literature review.)

Beach, A. F., and Hankam, E. V., "Bibliography on the Use of IBM Machines in Science, Statistics and Education," International Business Machines Corp., New York, 1954 (A bibliography.)

Proceeding of the Institute of Radio Engineers, October 1953. (A collection of 41 articles of current developments.)

Berkeley, E. C., "Giant Brains," John Wiley & Sons, New York, 1949 (A popular account.)

Industrial & Engineering Chemistry, Nov. 1951, pp. 2241-2486. (Ten papers on applications of computers to chemical engineering problems.)

Chemical Engineering, Dec. 1950, pp. 117-130 (A report.)

Case studies (next page) show how engineers are using computers ——→

Here Are a Few Typical Applications of Computers in Chemical Engineering

Case Study I—Process Stream Analysis

Problem—In evaluating performance and controlling the composition of process streams in experimental or production units, frequent analyses must be performed. Separation methods, such as distillation and extraction, are often bypassed and the unseparated mixture analyzed directly by infrared or mass spectrometry. The intensity pattern as obtained from the instrument must be subjected to mathematical analysis in order to obtain the results. A set of simultaneous equations, one for each component analyzed, must be solved. Above six components, ordinary desk calculator methods become prohibitively slow. Analog computers have been in common use since World War II, but they are quite time consuming for 10 to 12 equations and are not equipped to handle more than 12 directly. Since process streams with as high as 24 components are encountered in some operations, the solution of these equations may become a bottleneck in following and controlling process streams.

Solution—The use of automatic computing machines is gradually becoming the standard method for these calculations. A number of articles have described the procedures for this application. Thus far, most of the work has been done on punched card equipment, but direct feed to magnetic drum machines is in the offing. While both of the automatic procedures used may be done with a desk calculator, machine methods offer the advantages of extreme speed, automatic checking, and saving of personnel.

The preferred method uses the inverse matrix, which is simply the general solution of the set of simultaneous equations involved. The calculation of the inverse matrix is quite time consuming and contains several pitfalls for the inexperienced. A saving of about 90% of the desk calculator time can be made with punched-card machine methods. Using a drum computer, a further tenfold reduction in time may be possible. In practice, most spectrographic-computing installations require matrix inversion infrequently comparted to individual sample calculation. The latter is performed by a straight sequence of multiplications and additions. Using punched card machines takes 1 to 5 min. per sample.

Significance—With mass spectrometry and infrared laboratories freed of the drudgery of long computations, more effort can be given to speeding routine samples. As a consequence, when machine methods are installed, the number of multicomponent samples handled rises and consequently more process information becomes available. Newest developments call for combining of analysis machine and computer into an integrated unit.

For this problem applicable references include: (1) Opler, A., *Anal. Chem.*, **22**, 558 (1950); (2) King, W. H., Jr., and Priestley, W., Jr., *Anal. Chem.*, **23**, 1418 (1951); and (3) Sobcov, H., *Anal. Chem.*, **24**, 1386 (1952).

Case Study II—Distillation Calculations

Problem—In design of separation systems employing distillation or volatilization, time consuming trial-and-error calculations must be used. Both flash equilibrium and plate-by-plate distillation calculations are generally made in this manner. These calculations are quite laborious, especially when thermal effects and deviations from ideal behavior must be taken into account. Consequently, the number of these calculations performed is always kept to a minimum.

Solution—A number of methods have been developed for automatic calculation of plate compositions. These speed the process and free the chemical engineer from this routine task. More accurate calculations can be made, for the machine can be programmed to consider a number of deviations from perfect behavior.

Significance—Where one or two trial tower calculations were made before in an effort to locate the most efficient reflux, feed temperatures, take-off points, etc., a much larger number of complete calculations can be made and the trial results compared to select the optimum. Methods are available for handling batch and continuous processes for both binary and multicomponent systems. A variety of machines has been used.

Applicable references include: (1) Rose, A., and Johnson, R. C., *Chem. Eng. Prog.*, **49**, 15 (1953); (2) Opler, A., Heitz, R. G., *Ind. Eng. Chem.*, **43**, 2465 (1951); and (3) Donnell, J. W., and Turbin, K., *Petroleum Refiner*, **29**, No. 10, (1950).

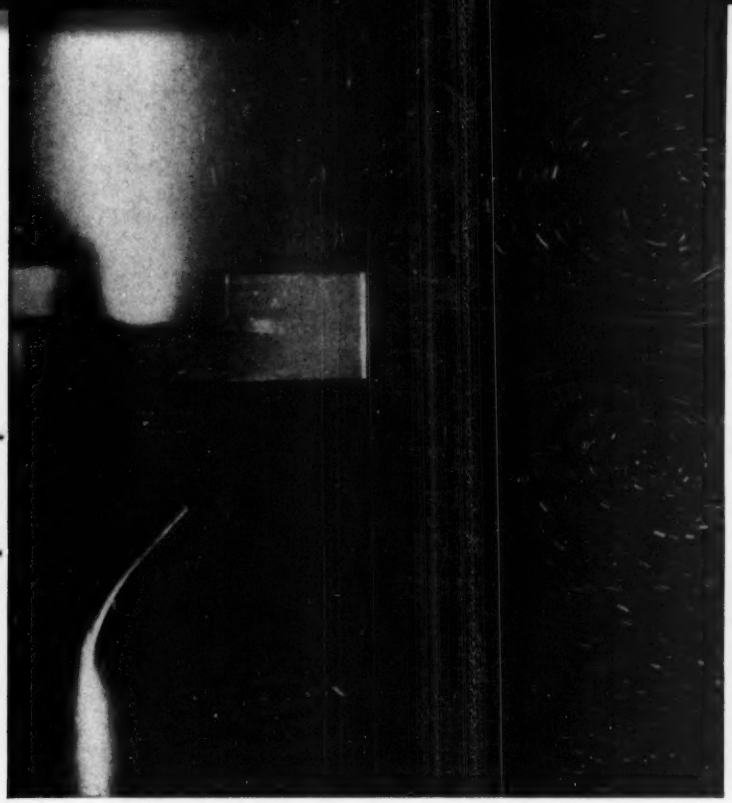
Case Study III—Mathematical Model of Physical System

Problem—Mathematical solutions of many engineering design problems are virtually impossible because of their complexity. Although the behavior of many isolated portions of a system may be well known, the combination of these into a solvable equation may not be practical. Examples of this occur in the design of reactors and absorption separation units.

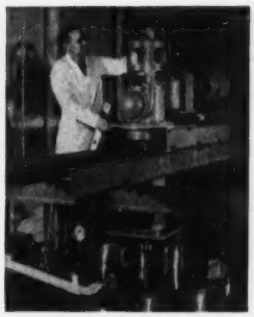
Solution—A mathematical model of the physical system under consideration may be constructed and operated with a computer. The programming instructions contain the information about the separate factors (rates, geometry, equilibria, temperature effects, flows, etc.) as well as the directions concerning application of the separate factors. The machine then carries out each step in the process and records the results. For example, the performance of an ion exchange tower may be calculated even though the equilibrium relations are complex, the rate controlling mechanisms vary and the feed rate and column geometry are irregular. The formulation and solution of the differential equations would be impractical, yet, using a mathematical model, this becomes a simple calculation to program.

Significance—Many design problems, hitherto solvable only by empirical tests followed by extrapolation, can now be treated by setting up and "operating" the corresponding mathematical model. Simulation by computing machine, long used in aircraft design, can now be added to chemical engineering techniques.

See, for example, Opler, A., *Ind. Eng. Chem.*, **45**, 2621 (1953).



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Chemical Engineering Fundamentals

Kinetics of Homogeneous Reactions—III

THOMAS E. CORRIGAN, Research Engineer, Mathieson Chemical Corp., Brandenburg, Ky.

Last month we detailed the numerical analysis of a complex reaction (*Chem. Eng.*, Sept. 1954, p. 210).

In this, our final installment on the kinetics of homogeneous reactions, we'll consider the calculation of reactor size—both for batch reactions and flow reactions—and conclude with some critical discussion of the latest theories of homogeneous reactions.

Calculation of Reactor Size

The most common use that the chemical engineer has for kinetics is the calculation of reactor size. For homogeneous reactions, this calculation can be divided into two classes—batch reactors and flow reactors.

In the batch (constant volume) reactor, typical kinetic equations involving concentration terms can be used without alteration. This is true because the change of concentration of a given substance is caused only by its formation or decomposition and not by a change of volume of the system as a whole.

In this calculation we usually want to calculate the length of time per batch, or the amount of initial charge, or the size of reactor needed if the production rate is specified for a given degree of conversion.

Flow Reactions

Many industrial processes conduct reactions in a flow system. Reactants are fed continuously into the reactor and the reaction takes place as the mixture proceeds along the reactor. In this case the pressure upon the reacting system is considered constant but the volume occupied by a unit mass of the reacting system usually varies. Reactions taking place in flow reactors are treated as constant pressure reactions.

The concentration changes of reactants in flow systems are due both to the reaction and to changes in total volume occupied by the reacting system. For this reason reactions in flow systems are treated using equations that involve partial pressures rather than concentrations of the ingredients.

The rate equation for the reaction between two gases, A and B, for a second order bimolecular reaction would be:

$$r = k_p p_A p_B$$

Therefore, it is important to be able to calculate the rate constant k_p if the value of the rate constant derived from concentration terms (k_c) is given.

For the case of ideal gases, this relationship may be readily calculated. Consider the ideal gas reaction

$$A \longrightarrow B$$

We can write the rate equation in terms of concentrations

$$r = k_c C_A$$

or in terms of partial pressures

$$r = k_p p_A$$

From the definition of concentration

$$C_A = n_A/V$$

that is, moles of A divided by the volume of the system. From the ideal gas law

$$p_A V = n_A RT$$
$$n_A/V = p_A/RT$$

Therefore,

$$r = k_c C_A = k_c p_A/RT = k_p p_A$$

and

$$k_p = k_c/RT$$

for a first order reaction. It can be shown in a similar manner that

$$k_p = k_c/(RT)^n$$

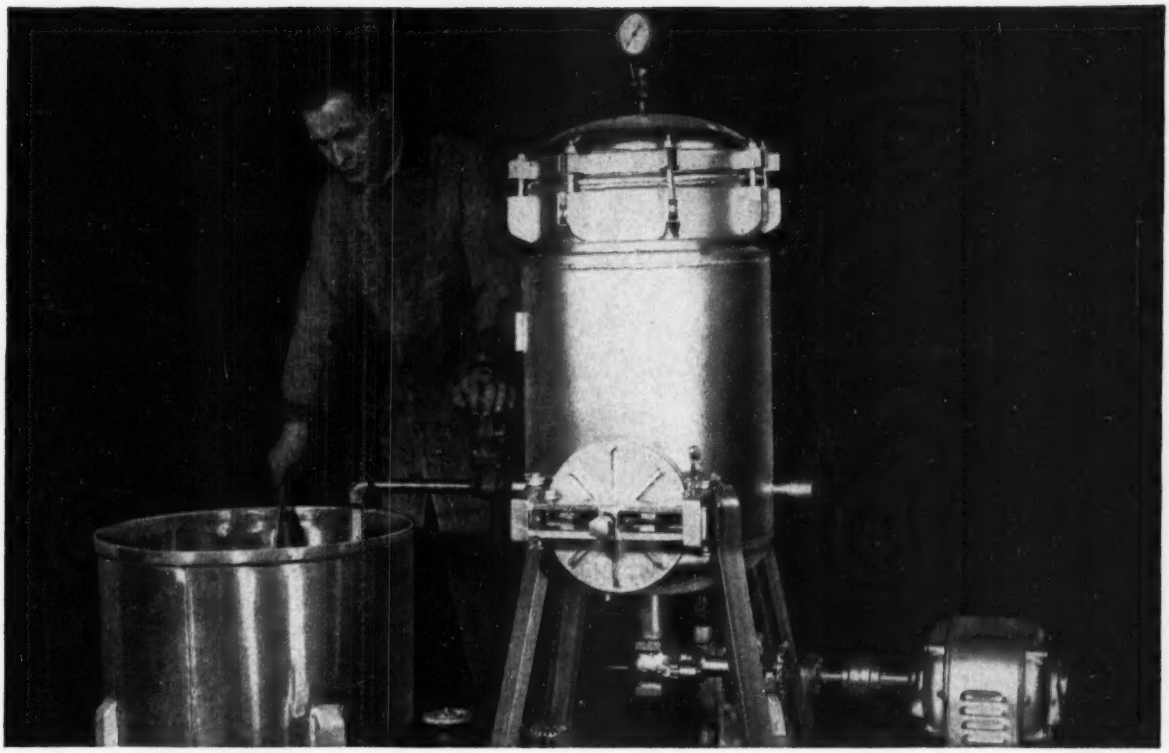
where n is the order of reaction.

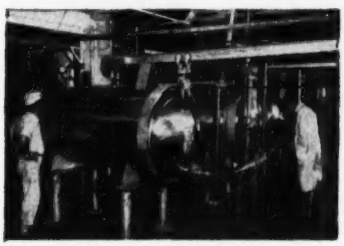
In calculations involving flow reactors there are two cases in which the rate equations based on concentrations may be used:

- Reactions in liquid systems.
- Gaseous reactions where there is no change in the number of moles.

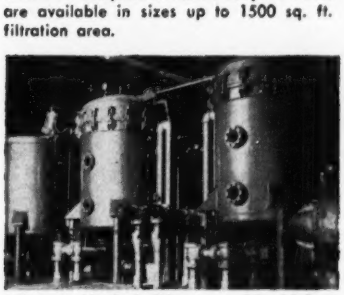
In the latter case, since the number of moles is constant, the volume occupied by a unit mass of the system does not change as conversion proceeds. Since this is the condition of a constant volume reactor, the equations of constant volume reactors (those using concentrations) may be used.

The average specific gravity of the mixture, in the case of homogeneous liquid systems, does not change





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Dimensions and Units for Rate Constants

Order of Reaction	Dimensions of k_c	Units of k_c	Dimensions of k_p	Units of k_p
1	1/time	sec.$^{-1}$	1/time	sec.$^{-1}$
2	$\frac{1}{\text{time}} \times \frac{\text{length}^3}{\text{mass}}$	$\frac{\text{liter}}{\text{sec.-gm. mole}}$	$\frac{1}{\text{time}} \times \frac{\text{length}^2}{\text{force}}$	$\frac{1}{\text{sec.-atm.}}$
3	$\frac{1}{\text{time}} \times \left(\frac{\text{length}^3}{\text{mass}}\right)^2$	$\frac{\text{liter}^2}{(\text{sec.})(\text{gm.-mole})^2}$	$\frac{1}{\text{time}} \times \left(\frac{\text{length}^3}{\text{force}}\right)^2$	$\frac{1}{(\text{sec.})(\text{atm.})^2}$

greatly with conversion. Therefore, for all practical purposes, the unit volume per unit mass of the system is constant and the constant volume equations may be used.

Units of the Rate Constants

We can see that the units of C_A or p_A do not affect the value of the constants k_c or k_p if the reaction is first order. In this case the dimensions of both k_c and k_p are 1/time.

For instance, if

$$dC_A/dt = kC_A$$

$$k = (1/dt)(dC_A/C_A)$$

or,

$$k = 1/t$$

In higher order reactions the units of k include concentration or pressure terms. Thus, if

$$dC_A/dt = kC_A^2$$

$$k = (1/dt)(dC_A/C_A^2)$$

and the dimensions of k are (1/time) multiplied by (1/concentration). See table above.

Calculation of Flow Reactor Size

Flow reactors may be classified as either of these two types:

- Reactors with complete mixing.
- Longitudinal reactors.

In the first class, the reaction mass is completely mixed. Therefore, the concentration at one point in the reactor is the same as at any other point.

The concentration in the longitudinal reactor changes along the length of the reactor as the reaction proceeds. It is assumed in the case of the longitudinal reactor that no mixing takes place in the longitudinal direction, but that the reaction mixture is completely mixed in the transverse direction.

The calculation of reactor volume for the reactor where complete mixing is assumed is a relatively simple matter. In this case the rate of reaction is constant at the value calculated for the final conversion. This is true because when complete mixing is assumed, the average composition within the reactor is taken as that of the effluent mixture.

For the longitudinal reactor the calculation is more like that of the batch reactor. The rate equation must be integrated to the limits of the conversion specified. If the rate equation is relatively simple, it may be integrated analytically; otherwise, a graphical or numerical integration method must be used.

Space Velocity and Volume/Feed Ratio

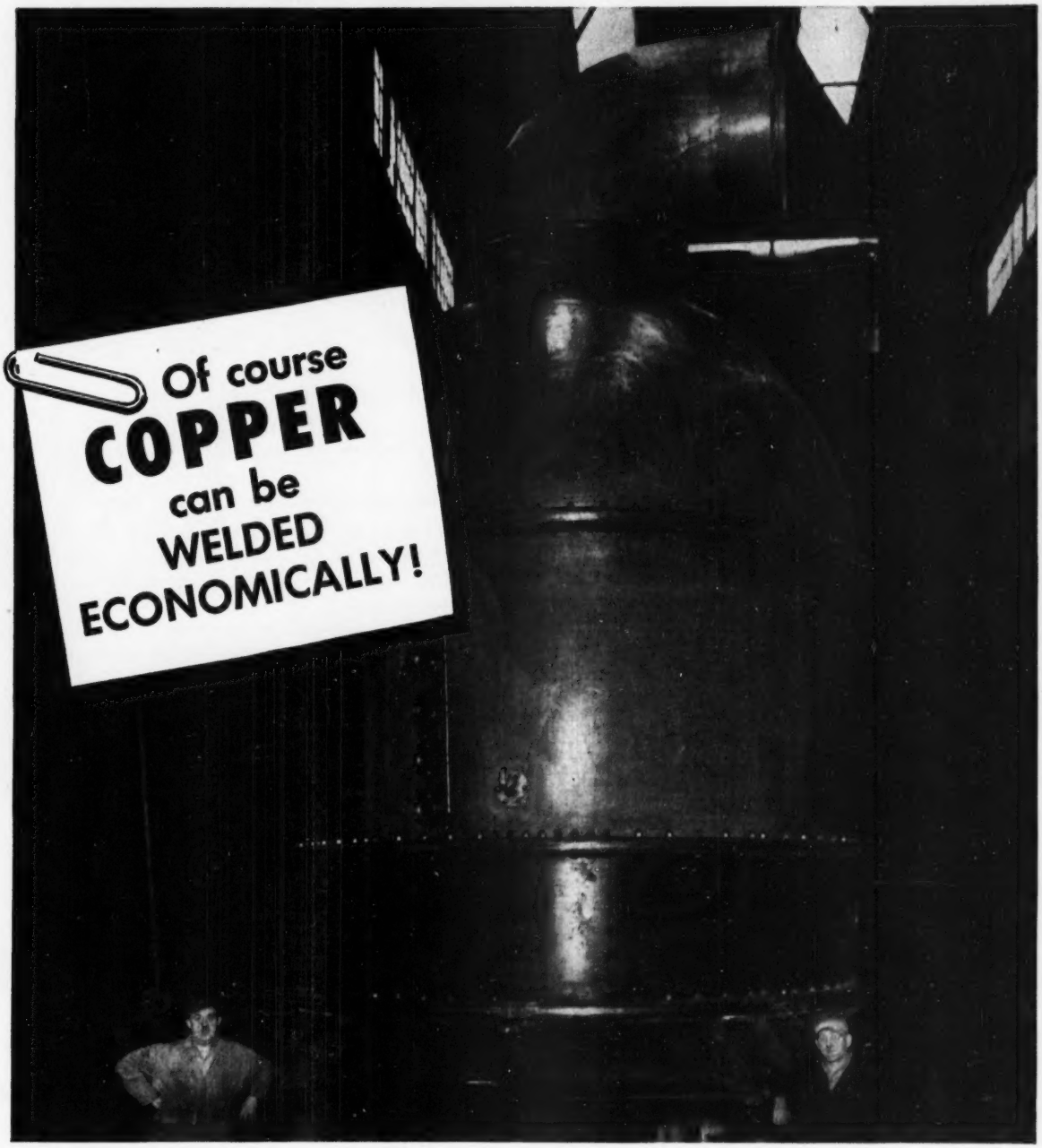
In flow reactor calculations "contact time" is not really the primary information that we want. Rather, the size of reactor needed for a given degree of conversion or the conversion to be expected from a given reactor are usually the quantities to be calculated. For

Nomenclature (Consistent units)

A	Term in the Arrhenius equation
A, B, C	Reactants
A^*	Activated molecule of A
$A^\ddagger$	Activated complex of A
C_A, C_B, C_C	Concentration of A, B, C, etc.
d	Differential operator
e	2.7183
E	Activation energy
F	Feed rate
$\Delta G^\ddagger$	Free energy of activation
h	Planck's constant
ΔH°	Heat of reaction in specified state
$\Delta H^\ddagger$	Free enthalpy of activation
k	Rate constant
k'	Rate constant, reverse reaction
k_c	Rate constant, concentration terms
k_p	Rate constant, pressure terms
K	Boltzmann constant
n	Order of a reaction
n	Number of moles
p	Pressure
r	Rate
r_f	Rate, forward reaction
R	Universal gas constant
s	Frequency factor molecules colliding
S_v	Space velocity
$\Delta S^\ddagger$	Entropy of activation
t	Time
T	Absolute temperature, °R . or °K .
V	Reactor volume
W	Weight of catalyst
x	Conversion

Additional subscripts

A, B, C	Of reactant A, B, C, etc.
1, 2, 3	Of reaction 1, 2, 3, etc.



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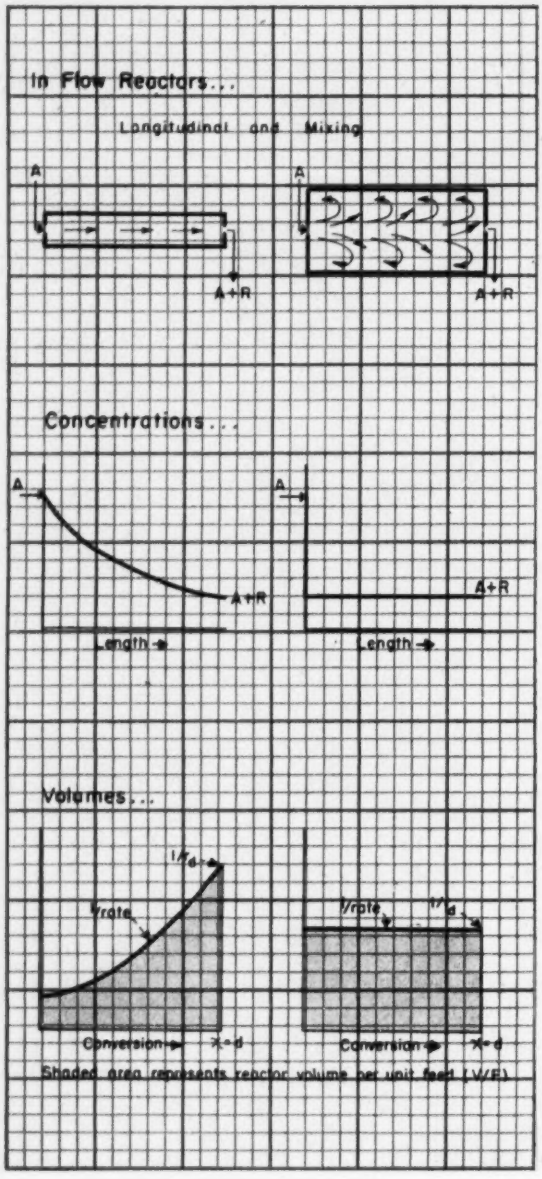
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this reason it has been found convenient to define a new variable, space velocity (S_v).

Space velocity is defined as volume of reacting mass (measured at some specified temperature and pressure) per unit volume of reactor per unit time. The specific units are usually

$$\text{(cu. ft.)/(cu. ft.)(hr.)} = 1/\text{hr.}$$

This is regarded as "reactor-fulls per unit time."

Since the dimensions of space velocity are reciprocal time, ($1/S_v$) may be used in place of time in rate equations. Another term in common use is the ratio, V/F, where V is reactor volume in cu. ft. and F is the specified feed rate in lb.-moles per hr.

The term V/F is proportional to contact time and may be used as a "time factor" in calculations involving flow reactors. The time factor V/F for homogeneous reactors is comparable with the time factor W/F used for catalytic reactors; where W refers to the weight of catalyst.

The feed rate, F, is usually specified along with the conversion, x, and the unknown quantity is V. For longitudinal reactors:

$$V/F = \int_0^x dx/r$$

and for mixed type reactors,

$$V/F = x/r_f$$

where r_f is the rate calculated for the effluent mixture.

Effect of Temperature on Reaction Rates

Up to this point we have discussed only the effect of concentration of the various constituents upon the rate of reaction, and we have limited our calculations to isothermal cases. The effect of temperature upon the rate of a reaction is very significant. In almost all reactions the specific rate constant is a logarithmic function of the reciprocal temperature.

Arrhenius[1] first observed the relationship when he plotted $ln\ k$ vs. $1/T$ and found the relation to be a straight line for many cases. If $ln\ k$ is plotted vs. $1/T$, a straight line is obtained whose slope is $-E/R$ and whose intercept is $ln\ A$.

The Arrhenius equation is:

$$\ln k = -(E/R)(1/T) + A$$

or

$$k = se^{-E/RT}$$

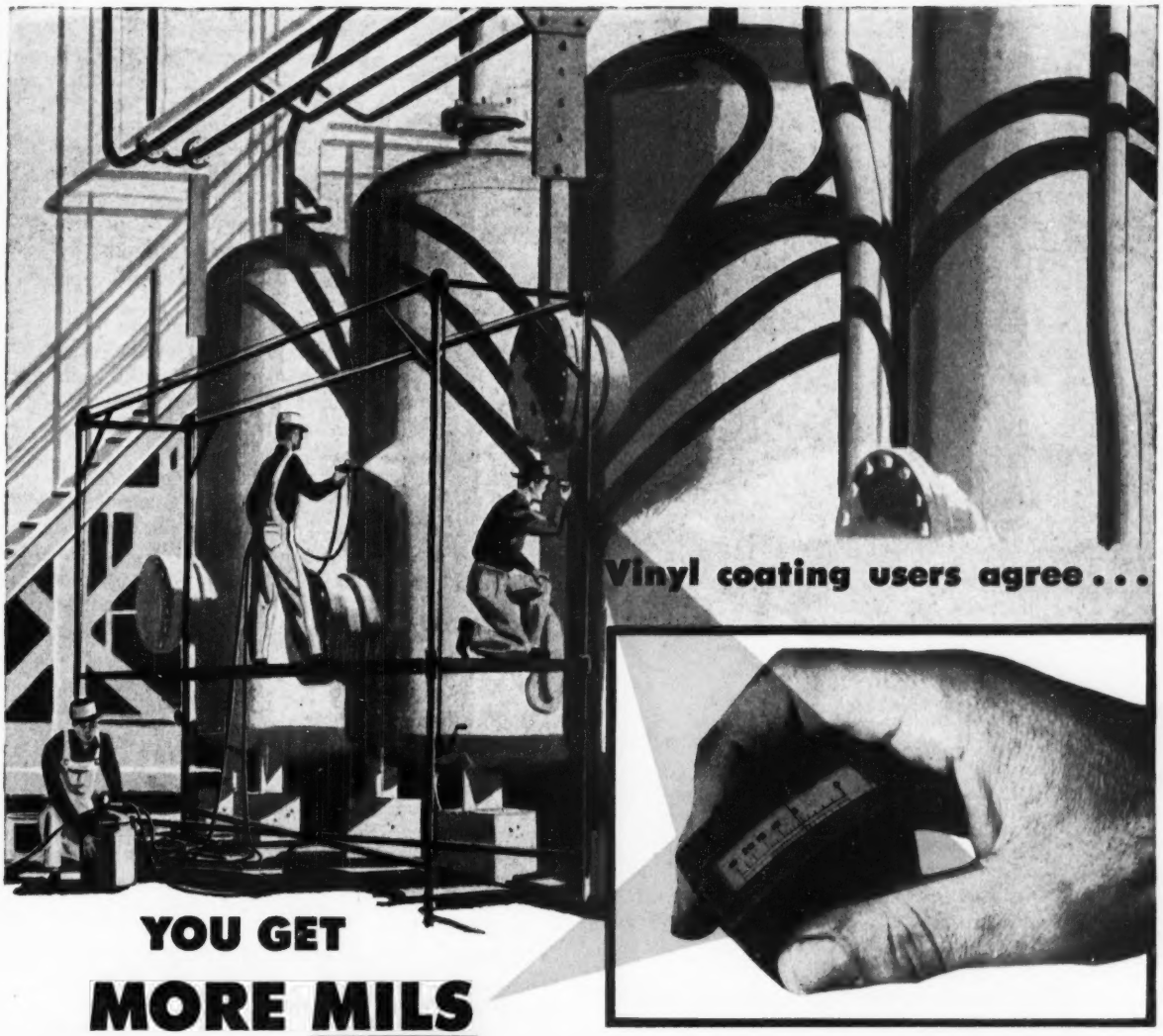
The constants E and s may be obtained as the slope and intercept when $ln\ k$ is plotted against $1/T$ for any reaction.

It can be shown from statistical theory that if E is regarded as a given amount of energy which a molecule possesses, the fraction of all reactant molecules present possessing E or greater amounts of energy is given by the expression $e^{-E/RT}$.

Therefore, we might assume that for a given reaction a molecule of reactant must possess an amount of energy at least equal to some specified quantity, E, before it can react. If s represents the total number of molecules colliding with each other (collision frequency) and if the fraction of those with enough energy to react upon collision is $e^{-E/RT}$, then the total number of molecules reacting would be:

Molecules colliding (s) times fraction of total molecules ($e^{-E/RT}$) with enough energy (E) to react. Thus, the term s is called the frequency factor and E is called the activation energy.

At first the activation energy, E, was regarded as a "heat" term and was compared with the heat of reaction, $\Delta H°$. Eyring[2] has since shown that energy of activation is really a free energy term and not an enthalpy term as had been previously supposed. Therefore, we can write this equation:



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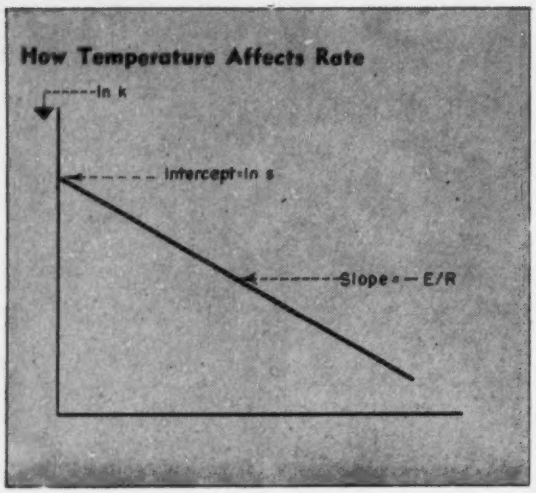
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$$\ln k = s\epsilon^{-\Delta G^{\ddagger}/RT} = s\epsilon^{-\Delta H^{\ddagger}/RT - \Delta S^{\ddagger}/R}$$

where $\Delta G^{\ddagger}$, $\Delta H^{\ddagger}$, and $\Delta S^{\ddagger}$, refer to free energy, enthalpy and entropy of activation.

Since for most reactions the plot of $\ln k$ vs. $1/T$ is a straight line (see cut), there have been attempts to attach physical meaning to the constants E and s.

However, as long as these constants must be determined from experimental measurements of k at various temperatures, any theoretical interpretation of their meaning neither adds to nor detracts from their usefulness to the chemical engineer who uses them in design calculations. For all practical purposes s and E (or $\Delta G^{\ddagger}$, $\Delta H^{\ddagger}$, and $\Delta S^{\ddagger}$) are merely the intercept and slope of a line obtained from experimental data.

Theories of Homogeneous Reactions

There have been several theories postulated in an attempt to rationalize the behavior of homogeneous reactions. Although it is convenient to classify reactions by order, the fact remains that a large number of reactions have orders which are fractional numbers; and very few reactions have an order which corresponds with the molecularity of the reaction.

Mere classification of reactions by order falls far short of providing a theoretical explanation of the kinetics of each reaction. Some of the more important theories of reaction mechanisms are:

- Radiation hypothesis.
- Collision theory: simple and modified.
- Chain reaction theory.
- Activated complex theory.

We'll discuss each of these briefly.

Radiation Hypothesis

The radiation hypothesis which will be discussed first is the least plausible and, in fact, has been disproved. According to this theory all chemical reactions were caused by radiation from the walls of the reaction vessel. It was assumed that infra-red vibration of a certain frequency coming from the walls of the reactor would cause a specific reaction to proceed. When the reaction was reversed it would radiate energy of the same frequency to the walls. Experimental evidence disproved the hypothesis quite readily, however.

One of the main factors in discrediting the theory was a series of experiments in which reactions were carried out with hot gases in reactors with cold walls. The reaction rate was found to depend upon the temperature of the gases only and to be quite independent of the wall temperature.

Although there are some reactions (photochemical) which depend upon radiation, the theory implying that radiation is important to all reactions is quite untenable and is only of historical interest.

The other three theories—collision, chain reaction and activated complex—are contemporary theories and are the prevalent present-day ones. They are congruent with each other and are all quite plausible.

Collision Hypothesis

The collision hypothesis holds that for a molecule to react it must collide with another molecule (or atom). Even upon collision it will react only if it possesses energy in excess of a certain minimum called the activation energy, E. The collision hypothesis gives physical meaning to the terms s and E in the equation

$$k = s\epsilon^{-E/RT}$$

There are several cases which the collision hypothesis fails to explain. These deal with the effect of pressure upon unimolecular reactions.

A modification of the collision hypothesis has been proposed to cover these discrepancies.[3] This modification states that there may be a lag between the time that a molecule becomes activated (by collision) and the time it reacts. During this time lag the molecule can either react or become deactivated; and there is, in fact, an equilibrium between activated and deactivated molecules. Thus,

$$A + A \underset{k_2}{\overset{k_1}{\rightleftarrows}} A^* + A$$

$$A^* \xrightarrow{k_3} B$$

The rate equation for this reaction would be

$$r = dC_B/dt = k_1C_A^2/[1 + (k_2C_A/k_3)]$$

At moderate pressure this would be

$$dC_B/dt = kC_A$$

and at extremely low pressures it would be

$$dC_B/dt = k_1C_A^2$$

Thus, at moderate pressures the reaction would appear to be first order and at low pressure second order. Some reactions behave this way in the laboratory.

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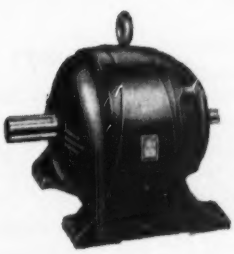
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Chain Reactions

Another explanation of reaction mechanisms is that the reaction is a series of intermediate steps comprising a chain. Individual steps within the chain may involve whole molecules or disjointed parts of molecules (free radicals). The hypothetical reaction

$$H_2 + Br_2 \rightleftarrows HBr$$

might conceivably take place in four steps:[3]

$$Br_2 \rightleftarrows 2\,Br \quad (1)$$

$$H_2 + Br \rightleftarrows HBr + H \quad (2)$$

$$Br_2 + H \rightleftarrows HBr + Br \quad (3)$$

$$H + Br_2 \rightleftarrows HBr \quad (4)$$

Particles such as H and Br are seen to be formed in one step and then to react with fresh reactants in another step. Such particles are called chain carriers.

At all times the actual concentration of the chain carriers is small compared with that of the reactants and products (H_2, Br_2 and HBr in this case). In the above reaction step (1) is called the chain-initiating step because the chain carriers are initially generated in it. Steps (2) and (3) are called chain propagating steps and step (4) is the chain-stopping step.

The over-all rate equation for a chain reaction may be that of a simple first order reaction or it may be a complicated equation involving fractional powers. As an example of the latter, the rate equation for the HBr reaction was found to be (see Ref. 3, p. 841):

$$r = 2k_{c_1}\sqrt{K_{c_2}Br_2}\,(H_2) - 2k_{c_4}'(HBr)\left[\frac{k_{c_1}\sqrt{K_{c_2}Br_2}(H_2) + k_{c_3}'\sqrt{K_{c_2}Br_2}(HBr)}{k_{c_3}'(HBr) + k_{c_5}(Br_2)}\right]$$

Because many processes proceed by chain reactions, the chain reaction theory is probably the most important one in the field of kinetics.

Activated Complex Theory

Eyring[2] has proposed that the reactants form an "activated complex" which in turn breaks down to form the products. Thus the reaction

$$AB + CD \rightleftarrows AC + BD$$

would take place by the following steps:

$$AB + CD \rightleftarrows \begin{pmatrix} A-B \\ | \quad | \\ C-D \end{pmatrix}$$

$$\begin{pmatrix} A-B \\ | \quad | \\ C-D \end{pmatrix} \rightarrow AC + BD$$

The transition is assumed to be a gradual one whereby the A-B bonds and the C-D bonds are gradually weakened and the A-C and B-D bonds are gradually strengthened.

The intermediate stage is the activated complex. This activated complex, according to Eyring, is at all times in equilibrium with the reactants. In the case of a very simple reaction such as

$$A \rightarrow B$$

the steps would be:

$$A \rightleftarrows A\ddagger \rightarrow B$$

The term $\Delta G^\ddagger$ is the free energy change for the formation of the complex

$$A \rightleftarrows A\ddagger$$

from the reactants. Likewise, $\Delta H^\ddagger$ and $\Delta S^\ddagger$ are the enthalpy and entropy change for the same reaction.

Eyring's theory is referred to as the theory of absolute reaction rates because he has developed the equation

$$k = \frac{T_{RT}}{h}\,e^{-\Delta G\ddagger/RT} = (\kappa T/h)e^{-\Delta H\ddagger/RT + \Delta S\ddagger/R}$$

In this expression κ is the Boltzmann constant and h is Planck's constant. From this equation absolute values of the rate constant, k, could be calculated if the values of $\Delta H^\ddagger$ and $\Delta S^\ddagger$ are known.

Kineticists hope that these values can be calculated from an estimate of the structure of the activated complex using methods of statistical mechanics. If this could be done, reaction rates could be evaluated without the necessity of experimental measurements on the specific reaction in question. This would indeed be a great advance in the field of kinetics.

Unfortunately, the reaction rate constants calculated in this manner check experimental data only very roughly and they can not be estimated close enough to be of practical application in reactor design. Until this method is perfected, engineers still must rely upon experimentally determined values of k. And for all practical purposes $\Delta H^\ddagger$ and $\Delta S^\ddagger$ are empirical constants obtained from plotting experimental data. Thus, the original Arrhenius form of the equation

$$K = Ae^{-E/RT}$$

is just as useful as Eyring's form for the present.

REFERENCES

1. Daniels, F., "Chemical Kinetics," Cornell University Press, Ithaca, N. Y. (1938).
2. Glasstone, S., K. J. Laidler and H. Eyring, "The Theory of Rate Processes," McGraw-Hill Book Co., Inc., New York (1941).
3. Hougen, O. A. and K. M. Watson, "Chemical Process Principles," John Wiley & Sons, Inc., New York (1947).

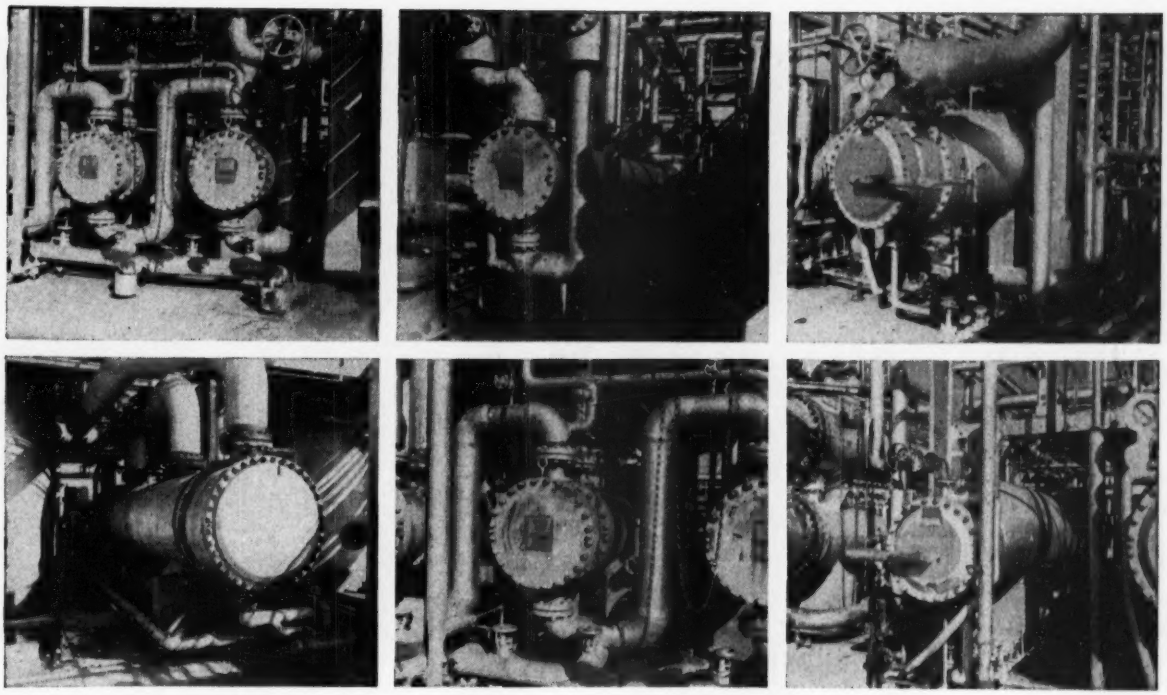
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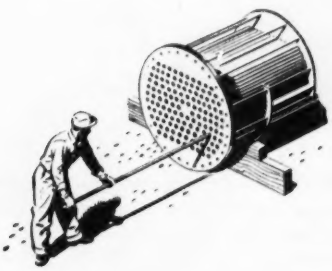
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REPUBLIC STEEL

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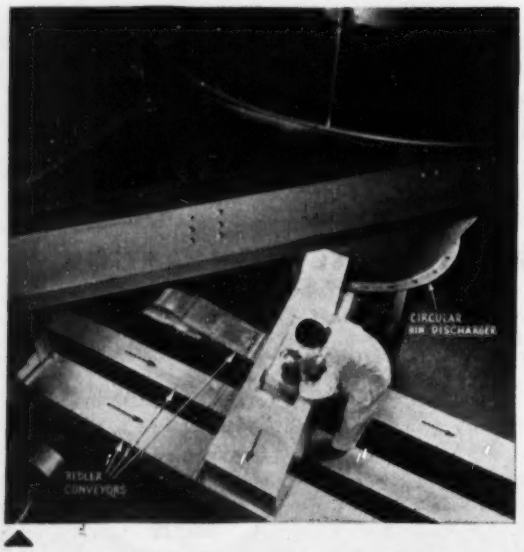
BOILER, CONDENSER AND HEAT EXCHANGER TUBES



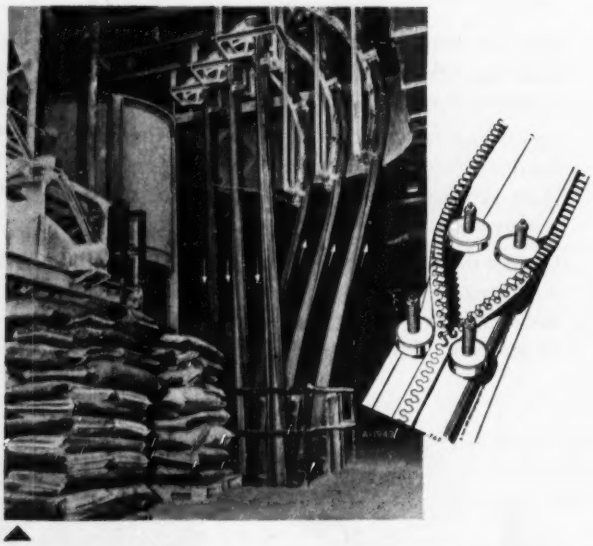
SALT AT 302° F. for the production of metallic sodium is distributed to Downs cells by these two REDLER Conveyors at an Ohio sodium plant. One step in an operation that includes purifying, drying, storing and reclaiming, these recirculating REDLERS not only distribute the salt to the processing cells but return any excess to storage. Equipment engineered by S-A at this plant includes screw conveyors, bucket elevators and several REDLERS besides those shown here. Other S-A equipment handles steam coal.

Conveying Any

From Hot Salt to Sulphur . .



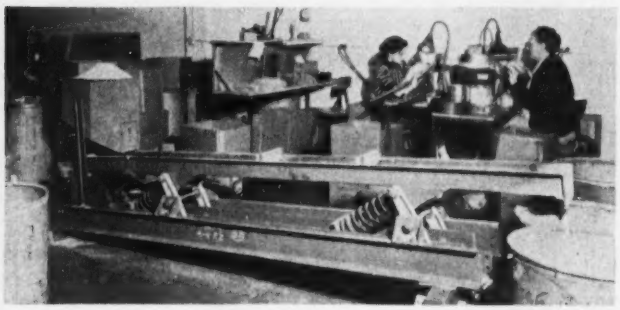
72 S-A CIRCULAR BIN DISCHARGERS feed cellulose acetate to processing operations at this Tennessee plant. Discharging to S-A REDLER Conveyors, the bin dischargers are designed to prevent arching of material and to insure steady flow. 57 REDLER Conveyors move material to and from storage and to processing without contamination.



NO CONTAMINATION HERE—Conveyors that zip tight move granular resin between dryers and storage bins. Immediately after receiving, the teeth in these S-A Zipper belt conveyors mesh and form a sealed tube that moves with the load. Each unit handles 1500 lbs. per hour. The simplicity of S-A Zipper units simplifies conveyor-elevator layout problems, since a single unit and drive can replace as many as three conventional units.



CORN COBS FOR MAKING FURFURAL ride on this S-A belt conveyor at a Nebraska chemical plant. Used in the manufacture of nylons, refining of lubricating oils and for scores of other purposes, furfural requires the moving of huge volumes of light weight raw materials. The S-A conveying system in this plant utilizes belt, screw and flight conveyors, as well as bucket elevators and enclosed REDLER conveyor-elevators to do the complete handling job.



▲ **IN A MOLDED PLASTICS PLANT,** a single S-A natural frequency conveyor serves as a feeder, sorting table and tramp iron remover. As it vibrates, it turns plastic parts over and over so that inspectors can spot and remove defectives. In a separate salvage operation, magnets hung over the trough remove metal components so that the plastic can be reused in injection molding machines. The unit is moved about the plant, since vibration to the floor is dampened, so that bolting to the floor is unnecessary.

Bulk Material...

Safely - Cleanly - Economically

In the chemical processing industry it takes various types of conveying systems to meet all needs. That is why the S-A Conveying Engineer is a good man to plan the job!

He is a specialist working with an unlimited choice of bulk materials handling equipment. Because Stephens-Adamson makes every kind he is unbiased, guided only by what the system will be called upon to do and how to get the best results at lower handling costs per ton. He is backed by the able S-A Engineering Department—a group that has successfully solved hundreds of tough bulk materials handling problems for over half a century. Whether *your* goal is lower cost handling, protection of product or personnel or any other advantage, the S-A Engineer is the "answer man" it will pay you to know. Write and we'll arrange a meeting without obligation to you.



SULPHUR TO DEODORIZE GASOLINE ▶ is handled by this S-A skip hoist at a Texas refinery. Both gasoline and kerosene are treated in these sulphur towers to convert odorous mercaptans to odorless disulphides in the "doctor sweetening" reaction. The 10-cubic foot skip hoist discharges to a hopper equipped with a swivel spout that feeds any of four openings.

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Engineering Division

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Standard Products Division

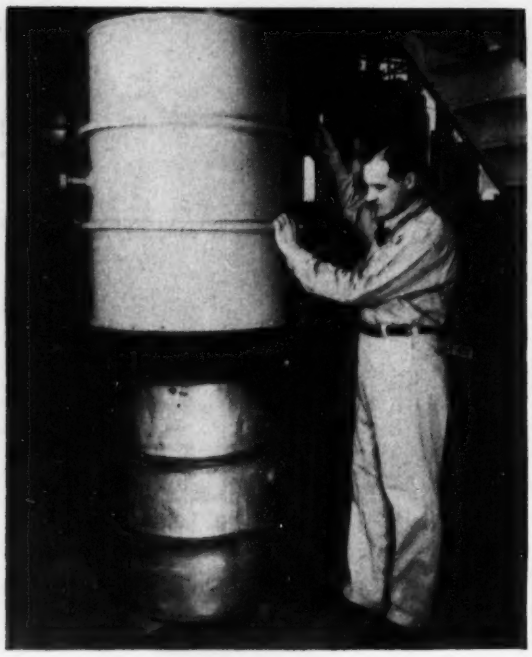
A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

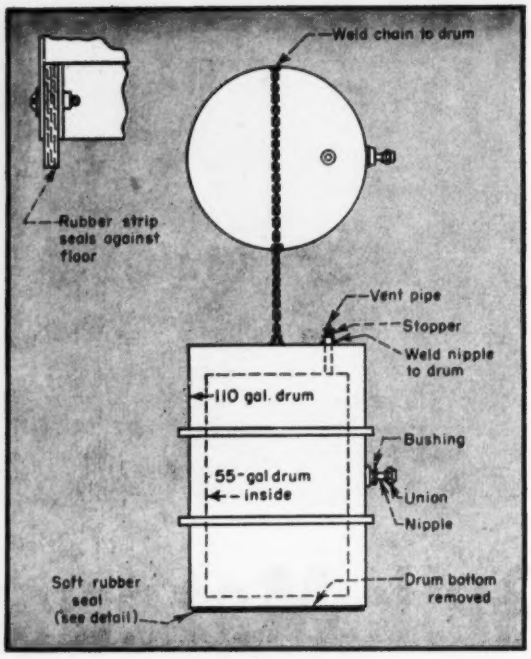
SealMaster Division

A complete line of industrial ball bearing units available in both standard and special housings.

The Plant Notebook

Edited by Theodore R. Olive





Steam-Heated Drum Melter Saves Time and Money

PAUL VANDEVEN, *Pilot Plant Engineer, Monsanto Chemical Co., St. Louis, Missouri.*

★ **July Contest Prize Winner**

The heating of 55-gal. drums to melt crystalline materials or to reduce the viscosity of liquids received in drums is a problem frequently encountered in semi-works, low volume production, or formulation operations. A highly satisfactory solution for our operations consists of a steam-heated portable drum melter which heats a single drum.

The unit is completely portable and may be used wherever a supply of atmospheric steam is available. Condensing steam is a much more efficient heat transfer medium than hot air and therefore this "steam hood" can melt a container many times more rapidly than larger hot-air cabinet melters. This factor is particularly important in the case of heat-sensitive materials. Low initial cost, flexibility and the saving in operating space compared with a cabinet melter are among the other advantages of this device.

The melter is constructed from a discarded 110-gal. drum from which one end has been removed. The drum is placed over the 55-gal. drum to be melted. Essential changes are a 1½-in. close nipple welded on top of the "melter" through which the drum vent is passed, and a

---

★ **August Contest Prize Winner.**

"Simple Design Fits Coil to Outside of Cone-Bottom Tank."

A prize of $50 in cash will be awarded to Stanley Grossel and Herman D'Aulerio, project engineers with the Barrett Div. of Allied Chemical & Dye Corp., Philadelphia, Pa. The article will appear in November.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable but non-winning articles will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

YOU CAN CLEAN THIS STRAINER

without interrupting production or contaminating the product

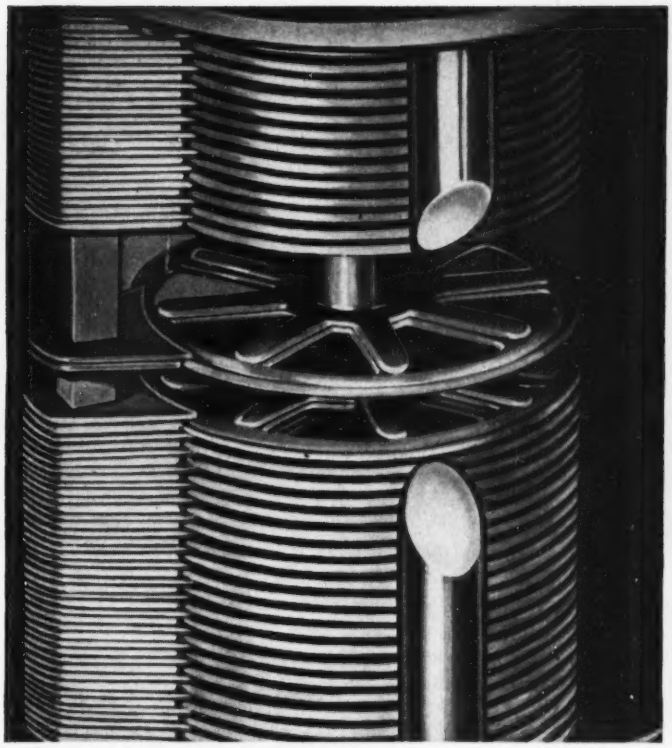
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Cuno AUTO-KLEAN Strainer is the *only* fluid cleaner on the market that works uninterruptedly. It's continuously-cleanable without stopping flow and without dismantling. An occasional turn of a handle—while in operation—combs out dirt accumulations. This can also be done *automatically*.

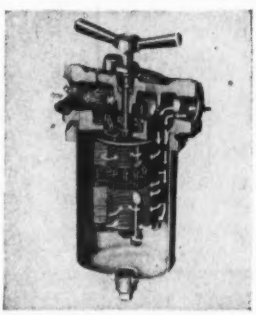
Thus—no loss of production, no chance of contaminating the product from exposure during element cleaning or replacement.

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- ☐ Lacquer
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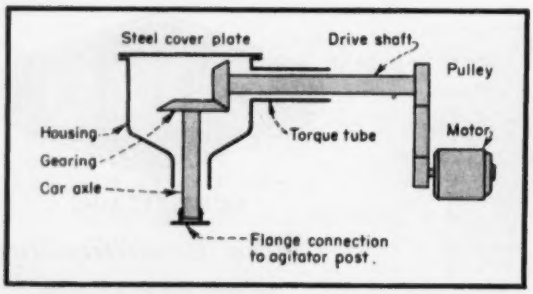
PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

connection from the side bung of the melter to a steam supply via a 2x¾-in. bushing and ¾-in. nipple with union for connecting to a ¾-in. steam hose.

Refinements which aid the operation of the melter include a chain welded to its top to facilitate lifting it over the drum; and a soft rubber sealing gasket around the bottom to minimize the steam vented to the air. A No. 9 rubber stopper may be fitted over the drum vent to provide a seal between it and the 1½-in. nipple on top of the melter and eliminate possible contamination of the drum by moisture. If the drum to be melted is placed on bricks to permit heating on bottom as well as sides and top, greater efficiency results.

In operation, the drum to be melted is placed on end on three bricks and a ½ x 8-in. nipple inserted in the end bung to serve as a vent. The melter is then lowered over the drum so the vent protrudes through its top opening, and the rubber stopper is inserted to seal the opening. The steam hose is connected to the side opening of the melter and atmospheric steam is applied to the melter. The condensate, plus a small amount of steam, leaks out around the bottom of the melter as the operation progresses.

A period of 2-3 hr. is required to melt a 55-gal. drum of material having a crystallizing point of 150-160 F. Total cost of the installation is only a few dollars if salvaged materials are used.



How to Get an Agitator Drive—in a Hurry

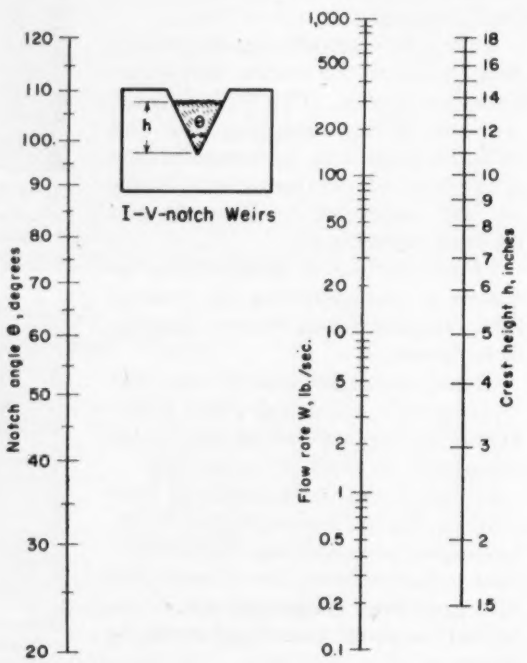
PAUL N. CHEREMISINOFF, *Technical Director, Joseph Turner & Co., Ridgefield, N. J.*

In a pinch, or if you can't wait for delivery of a tailor-made agitator drive, you can make one at little cost from a junked rear-end of a Lincoln, Mercury or Ford car, or Ford truck. Such rear-ends can be had at almost any junk yard for $10-15. However, only rear-ends from the cars mentioned—no matter how old—are suitable, since these are the only ones manufactured with a split rear-end housing.

Any such rear-end can be taken apart by unbolting the housing flange which divides the case enclosing the ring gear, differential and drive shaft pinion. Use the side of the housing which contains the automobile drive shaft, attaching your motor-driven pulley to this shaft. Your shop can readily adapt the differential gearing so that the ring gear will drive the pinion and agitator shaft through the car axle by means of a flange connection. Both drive shaft and axle can be cut to any convenient length, limited of course by their own dimensions.

If you wish you may leave the drive-shaft torque tube (4-5 in. diameter) to enclose the drive shaft (about 1½ in. diameter) for complete protection and lubrication. The housing may then be filled with grease and covered with a steel plate to insure adequate lubrication and protection. With this arrangement the gear ratio is set, but the agitator speed can be controlled or varied by the choice of motor speed or drive pulley ratio.

(Editor's Note—To use a rear-end for large-ratio speed reduction, see the methods described in the Plant Notebook for April and August 1951, where advantage is taken of the speed-reducing potentialities of the differential gear.)



Charts Give Flow Rates Over Weirs of Various Shapes

JACK LOWENSTEIN, *Chemical Corps Engineering Agency, Army Chemical Center, Md.*

These three nomographs solve the most commonly used weir formulas for triangular, rectangular and circular weirs. Actually, the last of them is two superimposed charts to take care of both outward and inward flow over circular weirs.

The first chart, for sharp-edged V-notch or triangular weirs, solves the equation:

$$W = 156(\tan \theta/2)^{0.996}h^{2.47} \qquad (1$$

where h is the head above the weir vertex in inches, and the other factors are as given in the table. Theoretically(

SARCO
Thermodynamic
STEAM TRAP



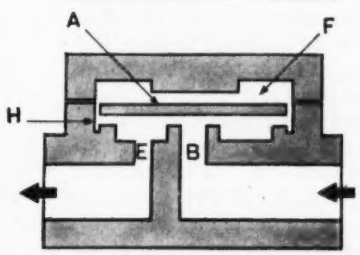
ACTUAL SIZE

this new trap virtually eliminates maintenance

SOLID STAINLESS STEEL DISC ACTS AS VALVE HEAD



HERE'S HOW IT WORKS!



Air and/or condensate raise valve seat disc A, discharge thru E. When steam follows, greater velocity causes it to strike body at H thus building up pressure in chamber F. This causes disc to seat, closing tube B. As pressure in F decreases by condensation, pressure in tube B raises disc and cycle is repeated.

The Sarco Thermodynamic Trap has proved successful on steam mains and separators; headers and soot blower pipes; engine and turbine stop valves, separators and casing drains; alternate heating and cooling applications.

2098-B

A solid stainless steel disc—practically indestructible—is the only moving part!

Most striking feature of the Sarco *Thermodynamic* Trap is its simple maintenance-free design. There's only one moving part—a solid stainless steel disc that practically lasts forever. There are no other moving parts to wear out or cause trouble.

Condensate, air and steam act directly on the disc valve which opens to discharge condensate and air—snaps shut to contain steam. There are no mechanical devices required to operate valve (see diagram at left). That means practically endless trouble-free operation.

Other advantages: small size, easy installation, not affected by shock or vibration, immunity to corrosive elements with all wearing parts stainless steel, same valve head and seat for all pressures to 600 psi and temperatures to 950° F.

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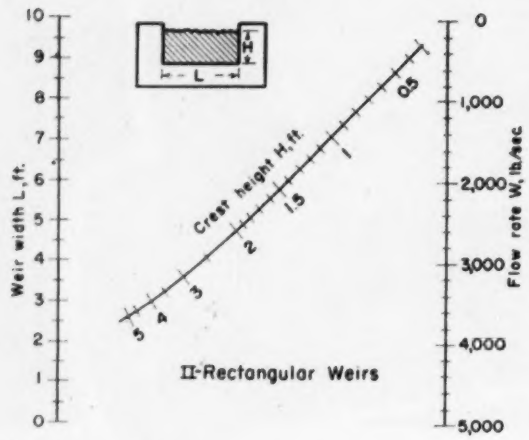
For installation on.....

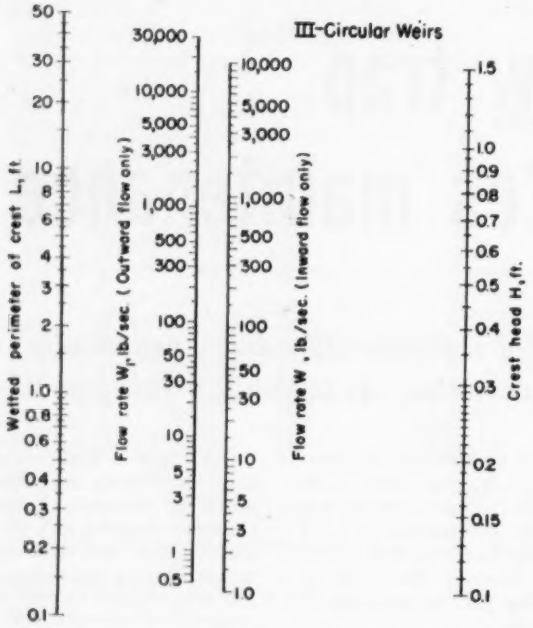
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this formula holds only for water. To correct it for other liquids multiply the results by $(z/s)^{0.43}$ where z is the viscosity relative to water at 68 F., and s is specific gravity relative to water. The correction is usually so small as to be negligible.

The second chart solves the Francis formula for sharp-edged rectangular weirs which, expressed in terms similar to Eq. (1), is:

$$W = 207.8(L - 0.2H)H^{3/2} \quad (2)$$

Here H is the head in feet, rather than inches, above the weir crest. Note that the W-scale is evenly graduated so that it can readily be extended if necessary.

The last chart, with its W_1 and W_2 scales, solves two different equations for flow over circular weirs. For outward flow, as represented by outflow from horizontal tanks and standpipes, the formula is:

$$W_1 = 124.8(LH)^{1.5} \quad (3)$$

For inward flow, over circular crests in a horizontal plane (e.g., flow into an overflow pipe), the formula is:

$$W_2 = 187.2(LH)^{1.4} \quad (4)$$

In the last two equations L is the length of wetted perimeter of the crest of the weir, while H is the height of head above the crest, both in feet. In using the last chart the appropriate scale for W_1 or W_2 is used, and the other one ignored. In using any of the charts it is only necessary to connect the dimension scales by a straight line and read the flow rate in lb. of water per second on the W, W_1 or W_2 scale. To convert to cu. ft. per sec., divide by the density in lb. per cu. ft., e.g., 62.4 lb. in the case of water.

It must be remembered that discharge from a tank, in the case of the circular weirs of the last chart, is affected by any agitation in the tank and that calibration is in therefore necessary in most cases.

NOMENCLATURE

- h Head of crest above vertex, inches.
- H Head of crest, rectangular and circular weirs, feet.
- L Width of rectangular weir, or wetted perimeter, feet.
- s Specific gravity relative to water, dimensionless
- W Flow, lb. per sec.
- W_1 Outward flow, circular weir, lb. per sec. (Eq. 3).
- W_2 Inward flow, circular weir, lb. per sec. (Eq. 4).
- z Viscosity relative to water at 68 F., dimensionless.
- θ Angle of V-notch weir, deg.

Again, the Hatchet Planimeter

A. T. Williamson, *Central Research Laboratories, Canadian Industries Ltd., McMasterville, Que., Canada.*

The Plant Notebook articles on the hatchet planimeter (p. 226, Apr. 1954, by J. T. Hogan, and p. 244, July 1954, by J. W. Langhaar) have correctly emphasized the simplicity and utility of this device for the measurement of areas. However, area measurement is only one of its applications and readers will be interested to know that it can also be used for the rapid graphical solution of some of the differential equations that appear frequently in thermodynamic, electrical and hydraulics problems.

These attributes of the planimeter were discovered by Albert Callender. For details of this use, refer to his original article (*J. Sci. Inst.*, **23**, 77, 1946).

Equations which yield to this technique are usually of the exponential decay types, with the length of the planimeter arm adjusted to match the time constant of the system. There are additional subleties, however, so that it is necessary to consult the reference mentioned for an understanding and appreciation of the method.

Editor's Note—Edward D. Henze, Edgewood, Md., has pointed to an error in an equation appearing in the original article of this series (p. 226, Apr. 1954). Mr. Hogan has checked and concurs that the two figures in the equation are in error, the correct form being:

$$\text{Area} = 0.035\,L^2 \arcsin[(AB + BA')/4L)]$$

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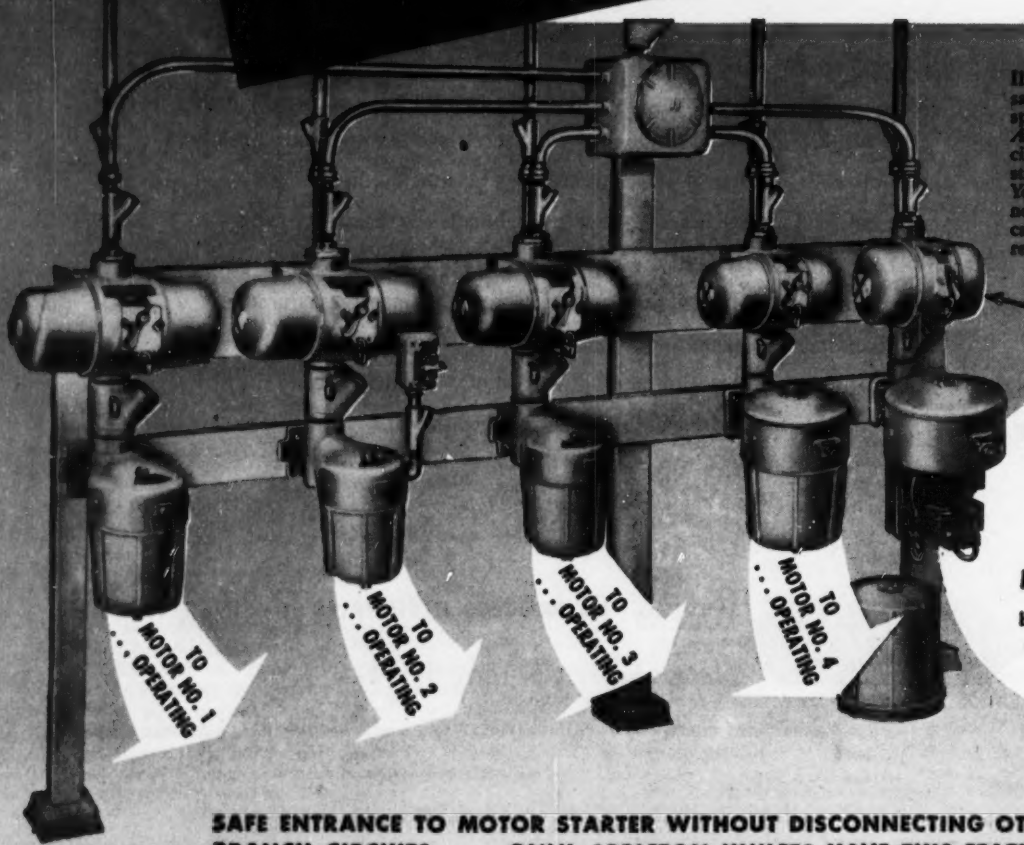


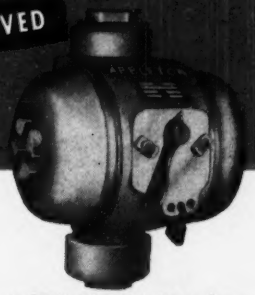
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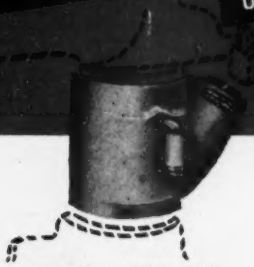
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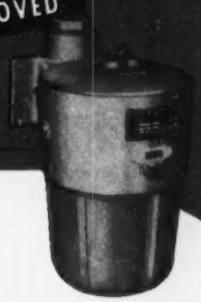
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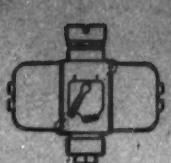


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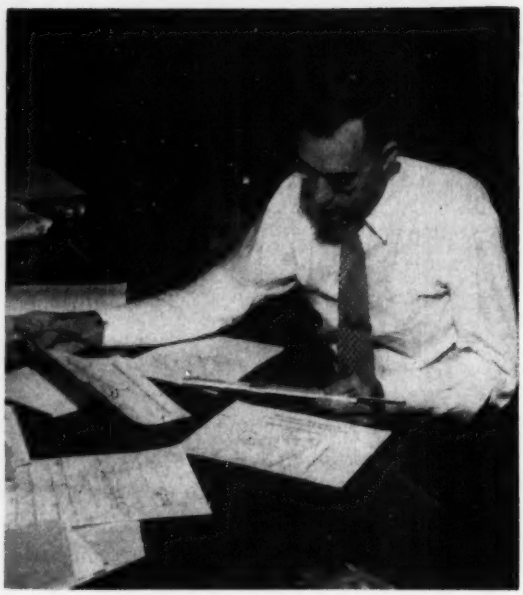
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How to Solve Engineering Problems

Problem-solving is a skill that every engineer must perfect. Here's how one company teaches its engineers to approach a problem—and to solve it.



L. W. Warzecha

In the past few years the General Electric Co. has done a great deal of work in developing an organized approach to the solution of the engineering problems which daily face its technical staff. A basic approach to problem-solving has been developed and presented to both the new engineers just beginning their careers with the company and older, experienced men.

However, while it was developed primarily for engineering situations, the approach is not restricted solely to these. It may also be applied to situations of a human relations, organizational, personal or business nature.

Why an "Approach" to Problems?

Why did General Electric feel it necessary to develop and teach a problem approach technique? The answer is simple. In college the embryonic engineer learns a vast array of factual information—countless details of the techniques and knowledge of many fields. He learns to apply this material to the solution of relatively simple problems in the particular area of knowledge being studied at the time.

For example, in a typical chemical engineering thermodynamics course in college the engineer would study the effect of various parameters on the efficiency of thermodynamic compressions and expansions. Then he'd work the series of exercises at the end of the chapter. To these he'd apply some basic relationships, as they were presented in the chapter.

Typically, he'd do this chapter by chapter throughout his college courses. Rarely would he have the opportunity to work problems that require an immediate understanding in several of the various technical fields.

How Good Is It?

This situation exists with most engineering graduates at the time they embark upon their industrial careers. To supplement the new graduate's knowledge, the General Electric Co. provides formal training in problem solving.

The problem approach has made the engineers much more effective in the use of their technical knowledge and in approaching new and different situations. It is fundamentally an organized procedure for solving any problem and a help to orient the individual's thinking in the solution of that problem. With it, the engineer can plan his time and work better.

This approach to problems is taught to GE's engineering recruits in its Advanced Technical Programs for those men who it feels are the future technical leaders of the company. To provide such training for key experienced men, Creative Approach Seminars are conducted.

An Eight Step Approach

The skeleton structure of the problem approach presented in GE's training programs consists of eight basic steps as follows:

- Recognize the problem
- Define the problem
  - Statement
  - Initial specifications
  - Investigation
  - Modified specifications
- Search for methods
- Evaluate the methods
- Select a method or methods
- Arrive at a preliminary solution or design

(Continued)

LAD WARZECHA *is the supervisor of the Advanced Technical Course of the General Electric Co. at Schenectady, N. Y.*



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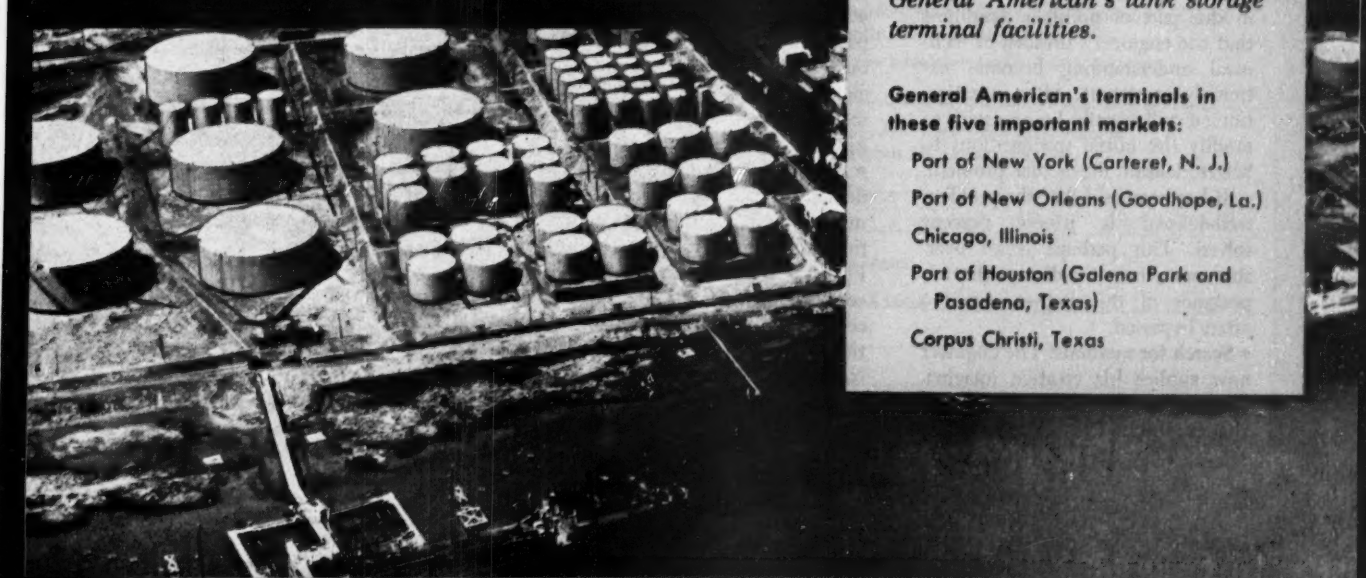
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An organized approach to problem solving boosts an engineer's effectiveness by helping him organize his time and effort.

- Interpret and evaluate the results
- Arrive at the detailed solution or design

Each of these steps is a necessary part of the complete solution of any problem. Now for just a little more in the way of explanation of each:

• **Recognize problem:** The engineer must obviously recognize the problem before he can solve it. It is very important that he be constructively discontent if he is to spot the unsolved problems that exist about him in his engineering working atmosphere.

• **Define problem:** He now defines his problem precisely, to be certain that he is actually solving the particular problem that needs to be solved. He determines what must be done in the time available, and the accuracy of the solution that is necessary. First he must set down a statement of what he considers to be the problem. After that he must set down an initial set of specifications on the solution of the problem.

Then he launches an intensive investigation to develop an understanding of the problem and the various aspects of importance. It is in this part of problem definition that the engineer's breadth of technical understanding becomes extremely important. After investigation, it will usually be necessary to modify the initial specifications to better delimit the actual problem.

It has been said that the problem well-defined is ninety percent solved. This perhaps is an overstatement, but it indicates the importance of this step—a step too often bypassed.

• **Search for methods:** The engineer now applies his creative imagination and creative techniques to determine methods that may possibly be used to arrive at the desired solution. A number of specialized techniques are very useful to increase the effectiveness of this search for methods.

One way is to turn off the judicial mind and just generate ideas, without any regard for their worth. Just think them up—no matter how "harebrained"—and judge them later.

One of the most effective means for idea generation is the brainstorm or creative session. In this type of session two or more men literally rain a deluge of ideas that might possibly be solutions to the problem at hand. As one man suggests an idea, this spurs the development of another idea in another man's mind, and so on. In this manner, many good ideas can be developed in a very short period of time.

• **Evaluate methods:** After his search for methods, the engineer makes a preliminary evaluation of each of the methods he is considering. Following this preliminary evaluation he will discard some ideas and make a more detailed evaluation of those methods that hold promise of providing successful solutions.

• **Select method or methods:** Comparing his evaluations of the various methods the engineer must judiciously choose that method which seems the most desirable and promising.

• **Arrive at preliminary solution or design:** At this point the engineer makes a preliminary design or solution based on the method chosen. For example, he may take a concept and try to reduce that concept to a practical device or practical solution to his problems. This is the area in which many of the preliminary details of the design or solution are worked out.

• **Interpret and evaluate results:** Again the engineer must evaluate what has been done. He must determine the validity of everything that has gone into his preliminary solution or design. He then evaluates this solution, makes any possible generalizations on the basis of it and proceeds to the ultimate detailed solution or design.

• **Arrive at detailed solution or design:** The engineer next follows through as dictated by his interpretation and evaluation of the results and his preliminary solution. At this point, he polishes up his design and establishes that this is the best solution he can obtain in the time available and with the cost permissible.

Recycling May Be Necessary

In working his problem, the engineer does not necessarily follow down through these steps in the exact order without ever reverting back to a step he has already taken.

Solution of an actual problem generally involves a certain amount of recycling through this entire problem approach process.

As the engineer conducts his investigation, he learns more about the problem, and hence can better define his specifications and better define his over-all problem. Then, as he searches for methods and begins to evaluate them, he learns still more of his problem and can again modify the specifications on his solution. As he performs more of the detail of his preliminary design and of the interpretation of his design, he again learns more about the over-all problem and he can modify his specifications further and perhaps generate more ideas.

Helps Organize Time and Effort

The problem approach, you see, is applied to any real problem in a more or less cyclic fashion. It is extremely helpful, however, to recognize these basic steps, for in performing these steps we can organize our mental effort and also our time in such a way as to make ourselves much more effective engineers.

Furthermore, we can recognize that this problem approach can be



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Modern jet aircraft pose tough hydraulic-line and fuel-line problems. High operational temperatures, new engine fuels and corrosive synthetic lubricants demand hose material that's strong and flexible. It must also be nonporous and impermeable, and function properly over a wide temperature range.

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used in the solution of either very lengthy problems or very small problems. That is, it can be applied to problems which require ten months, ten minutes, ten hours, or ten years for complete solution.

In a large problem, for instance, we would organize our approach on the basis of this step-by-step procedure, and then within some of the steps we might apply the same approach to the solution of that particular part of the over-all problem. In other words, we simply use a problem approach within a problem approach, to obtain the solution to the problem.

In General Electric, this problem approach has been extremely valuable to men who are doing engineering work in the design, development, applications, and manufacturing fields. To date it has been employed primarily in those fields, not because it is not applicable to others, but because it is so new that it has grown up in these fields and not had the opportunity to spread to other areas.

Applies to All Problems

We are, however, making efforts to spread a knowledge of problem approach to other fields of engineering and also to other professional fields. And we believe that it will find application in many other areas of endeavor. We find that it is equally as applicable to personal, organizational and business problems as it is to the technical problems that we face in our engineering sections.

Within the company more and more emphasis is being placed on problems approach; it is also becoming better known and understood outside of GE. And recently it has been attracting considerable attention in some of the colleges and in other industrial organizations.

STARTING SALARIES

. . . *Average $4,500*

Inexperienced chemists and chemical engineers are starting their careers this year at salaries about 5% higher than last year's group received, according to a nationwide survey conducted by the American Chemical Society. This is the second consecutive year that chemists' and chemical engineers' salaries have registered such an increase.

For chemical engineers with the bachelor's degree, the median starting salary has risen from $360 to $375 since last year. A breakdown of figures for chemical engineers shows that those completing a five-year curriculum for a bachelor's degree this year are receiving a median salary of $395 whereas the four-year graduates receive a $374 median.

Median salary for chemists who received the bachelor's degree this year is $364 a month, as compared with $351 in 1953. The 1952 figure was $325.

▶ **Ph. D.'s Gain the Biggest**–Median salaries also have risen for graduates with advanced degrees. Starting salaries for chemical engineers with the master's degree are up 5% from last year to $425, and chemical engineers with the doctor's degree have made the greatest gain–6.5% to a median of $575. Starting chemists with the master's degree report a median figure of $416 as compared with $404 last year. Those with the Ph.D. degree are up from $525 to $550.

Highest single salaries reported at various levels of training are: $800 a month for a Ph.D. chemist, $570 for a chemist with a master's degree, and $500 for a chemical engineer with a bachelor's degree.

For valid comparisons of chemists' and chemical engineers' earnings, it is necessary to compare salaries of men in each group who have accepted positions in corresponding employment categories. Since there are more women chemists (their median is $45 lower than corresponding male groups) than women chemical engineers, and since a greater proportion of chemists than chemical engineers enter the teaching field, the median salaries of chemists tend to be lower.

▶ **Regional Differences**–While salaries do not vary greatly from one area to another, both this year's survey and last year's indicate that highest salaries for bachelor degree engineers were obtained in the Pacific region and lowest initial wages are in New England. On the other hand, chemists with doctor's degrees received lowest starting salaries in Pacific states according to both surveys.

Highest salaries are offered by industry employers, followed in order by government, research institute and academic employers. The academic salary median for Ph.D. chemists is $420 a month–$97 less than that for the next highest employer class, the research institute.

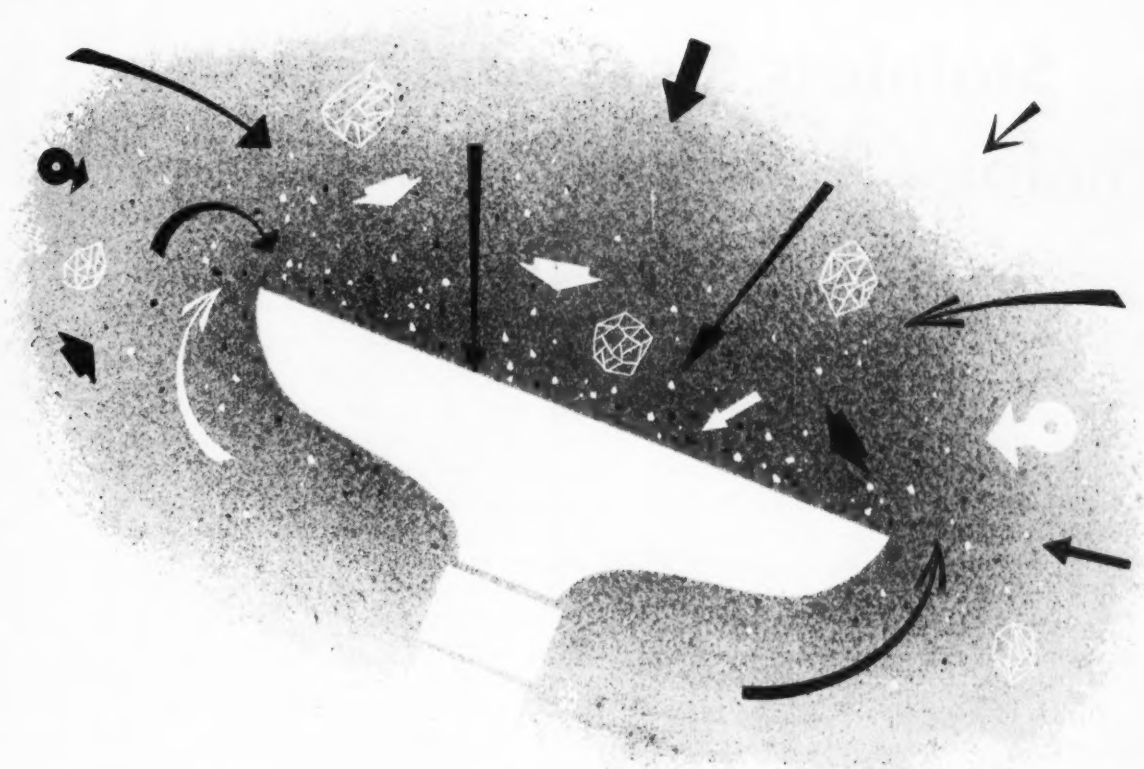
RESEARCH

. . . *Into Business Firms*

Carnegie Tech's Graduate School of Industrial Administration has recently received a grant of $132,000 from the Ford Foundation to finance a three-year program of research into the organization of business firms.

Human organizations, i.e., businesses, governments, etc., do most of the work in today's society. Yet we know more about workings of a pump or a motor and how it will react under various conditions than we do about the workings of these organizations. That's why we hear of such inconsistencies as a firm reorganizing to "decentralize" its activities one year and reorganizing again to "centralize" a few years later.

It is hoped that the findings of the School of Industrial Administration will enable the development of some scientifically based theories and principles to aid executives in making decisions of this sort.



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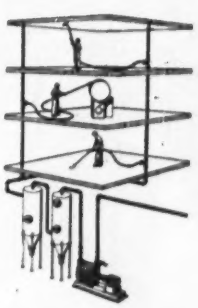
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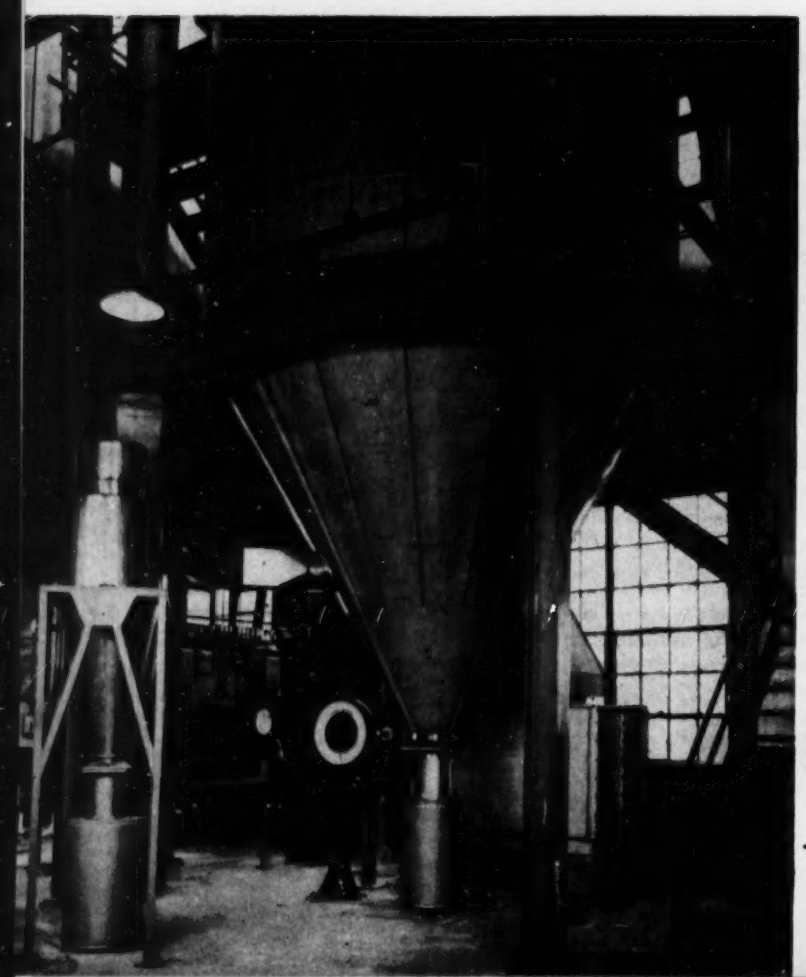
FOR 50 years, the J. T. Baker Chemical Co., Phillipsburg, N. J., has been supplying "Baker Analyzed" Reagents and other laboratory chemicals to industrial, pharmaceutical and educational users. Commercial quantities of Baker Chemicals are used in the pharmaceutical, electronics, photographic film, color and other key industries having specialized requirements for chemical purity.

The company has built its reputation on the purity and precision of its products and takes every precaution to insure these qualities. That's why Stainless Steel is used at all critical points in processing such chemicals as nitrates, acetates, sulfates, chromates, phosphates, carbonates and molybdates.

Stainless Steel is used in filters, pumps, reactors, pipes, valves, fittings and storage tanks. Even the ventilating system equipment in temperature and humidity-controlled rooms is Stainless Steel.

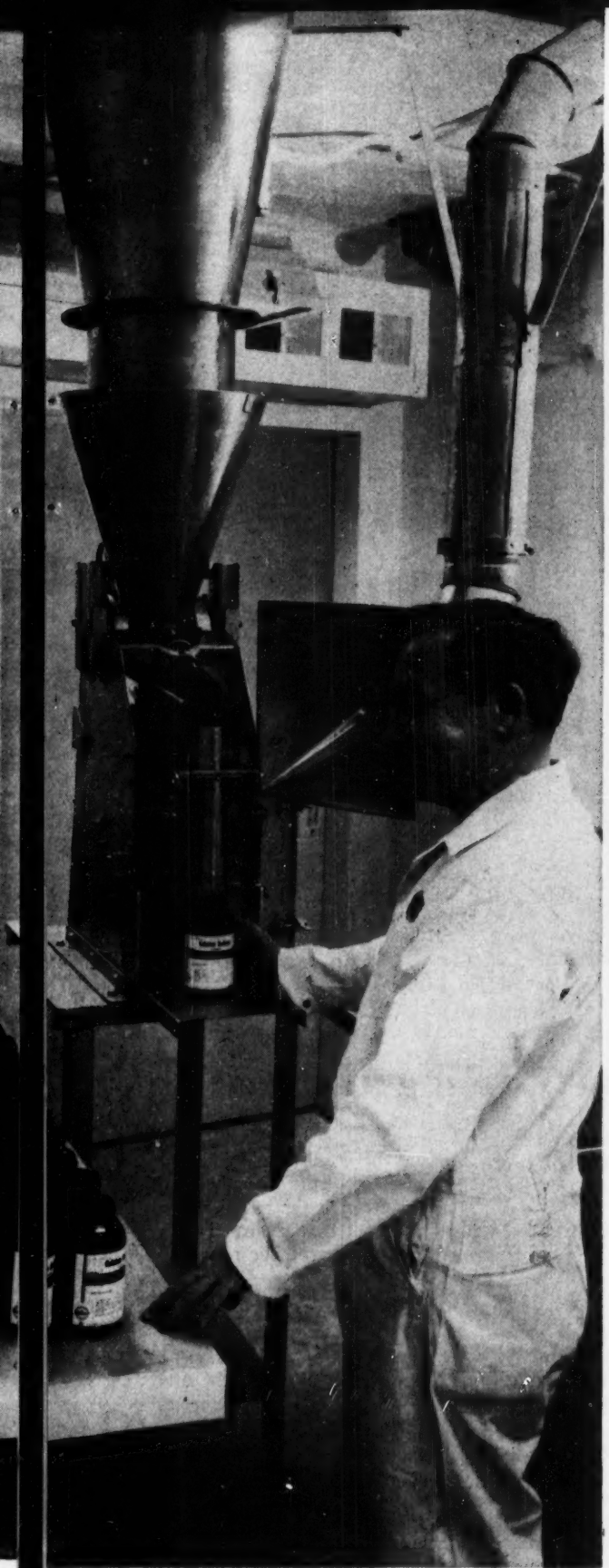
Company officials have found that Stainless Steel not only guards purity better and is easier to clean and keep clean, but it also has a life expectancy of 6 to 1 over other commonly-used materials.

If you are not taking full advantage of these qualities of Stainless Steel in your operations, investigate today. And when you purchase Stainless equipment, be sure to specify perfected, service-tested USS Stainless Steel; it is made to give you the finest performance.

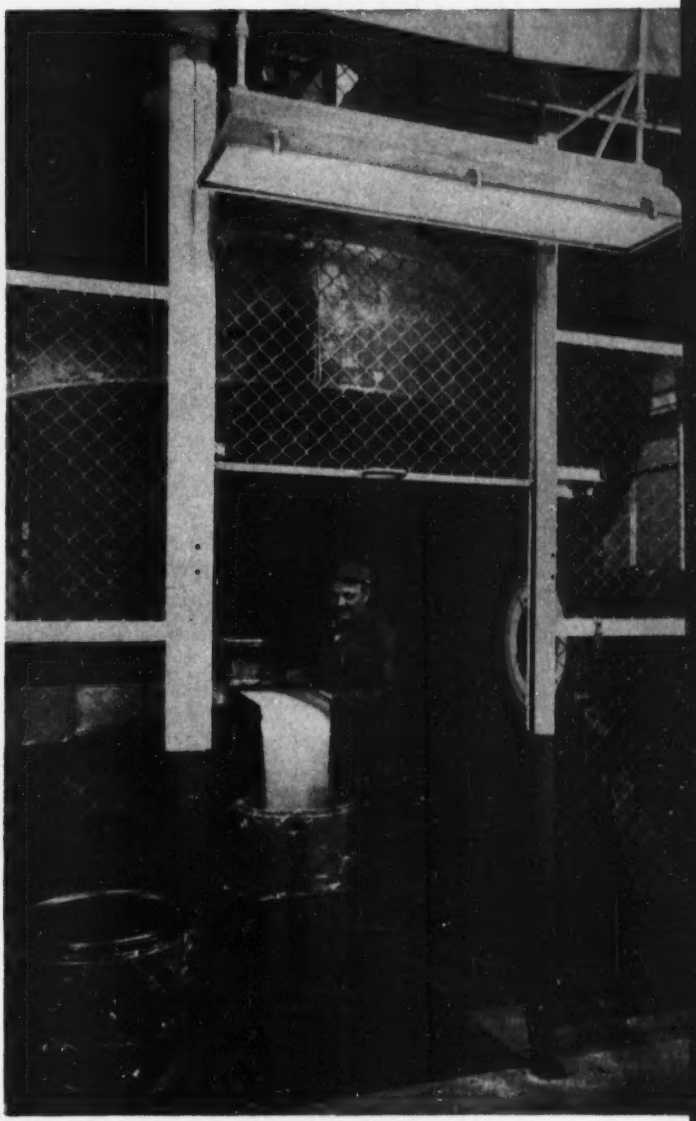




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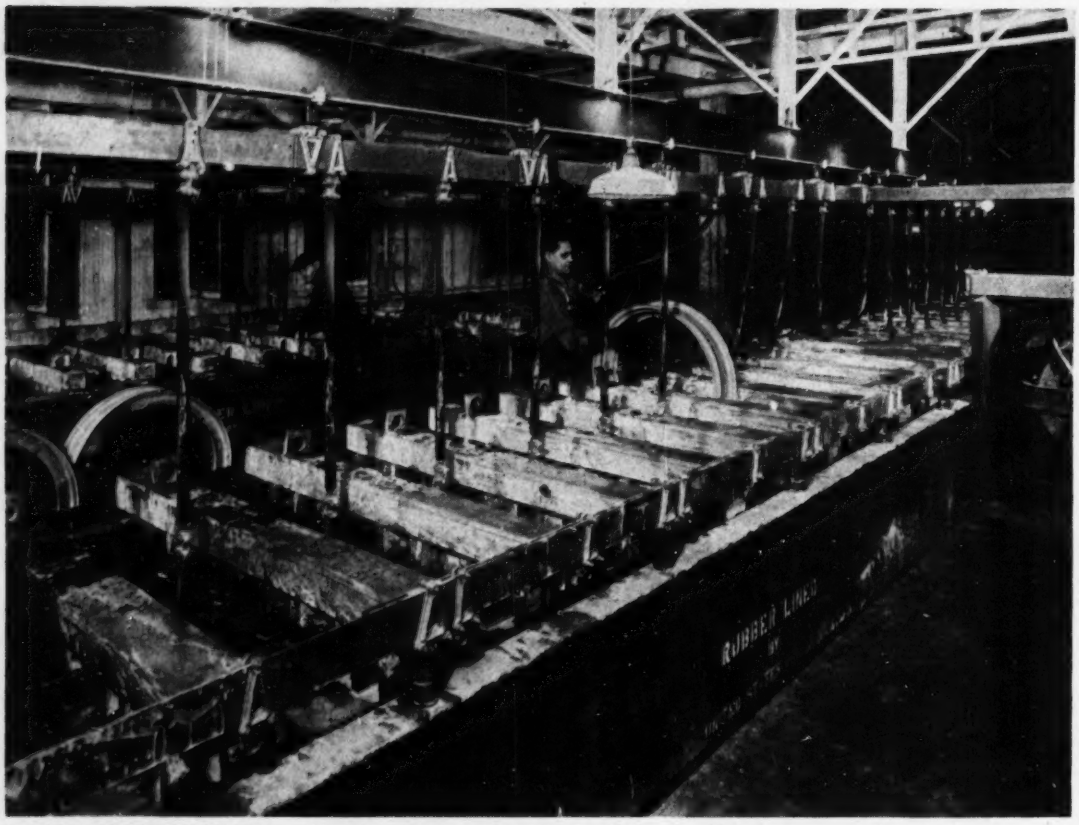
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Butyl Rubber—A Material Coming Up Fast

It's increasing in importance as a material for use in chemical processing. Until recently, supply had been limited and properties had not been fully investigated.

J. P. McNamee

Butyl rubber is more resistant to heat and oxidizing chemicals than natural rubber and the types of synthetic elastomers discussed in previous articles in this series (see Corrosion Forum, Aug. and Sept. 1954). This property makes butyl an important material to consider for solving corrosion problems.

J. P. McNamee *is a chemical engineer with the U. S. Rubber Co., Providence, R. I.*

Butyl rubber is a copolymer of isobutylene and isoprene. The isoprene content is very low (1 to 3%) with the result that butyl has less than 3% of the unsaturation of natural rubber. The resistance of butyl to heat and chemicals is the result of this low unsaturation.

This type of synthetic rubber is now well established as the best elastomer for automobile inner tubes. Its industrial applications, however, are increasing constantly because of excellent physical and chemical properties. Another important factor is the relatively low price of butyl as compared with other types of synthetic rubber.

Manufacture

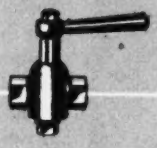
Butyl rubber is produced by reacting isobutylene with isoprene in the presence of a Friedel-Crafts catalyst at an approximate temperature of −95 C.

Isobutylene and isoprene in the proper ratio are dissolved in methyl chloride and cooled to the reaction temperature. A catalyst such as aluminum chloride, also dissolved in methyl chloride, is added and the polymerization reaction takes

Klingerise

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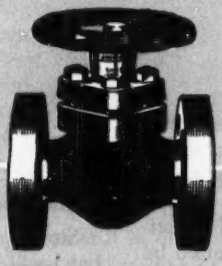
COCKS

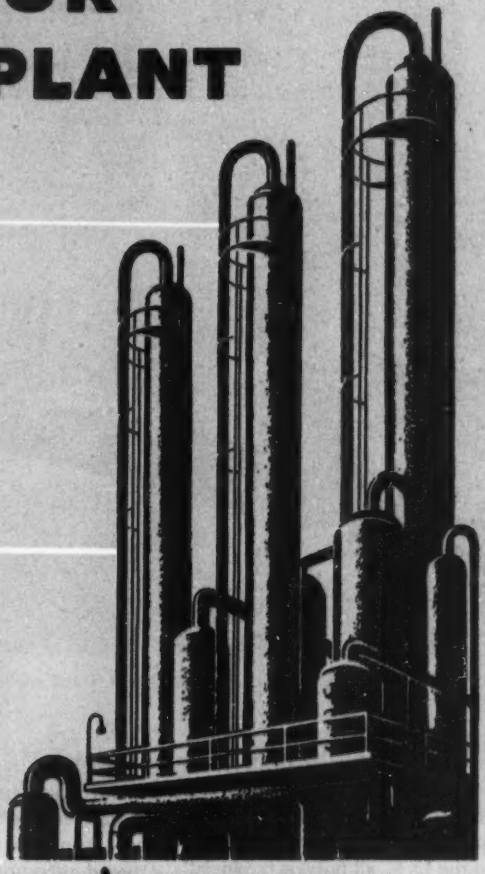


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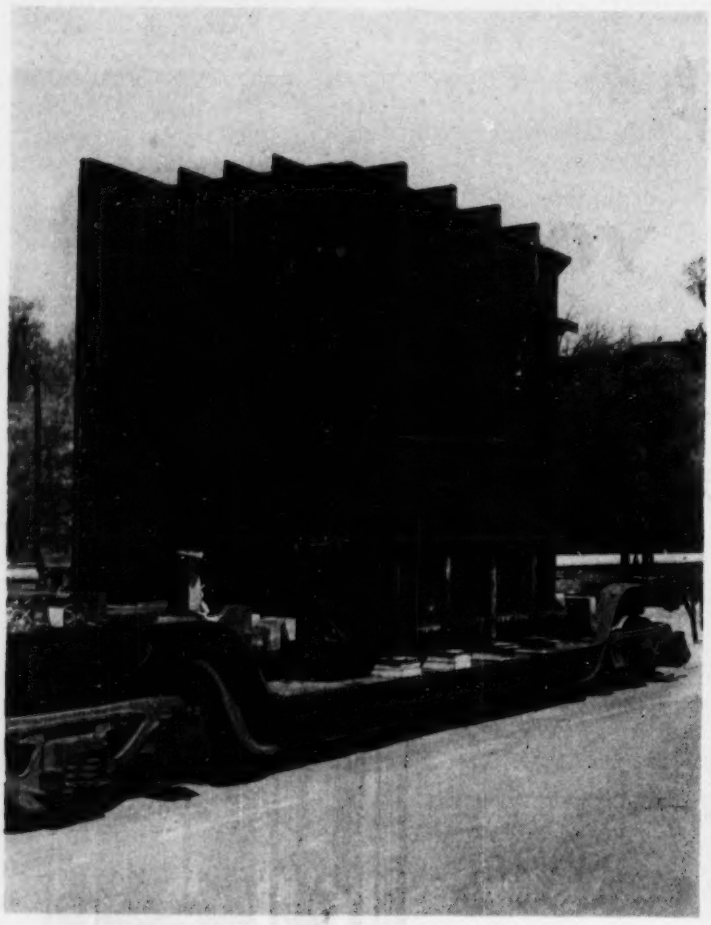
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STEEL WIRE CLEANING TANK lined with butyl rubber.

place. The reaction is continuous and crumbs of the product are filtered and dried to obtain the crude butyl polymer.

In the U. S., all butyl is produced and sold by the Office of Synthetic Rubber, Reconstruction Finance Corp. It is manufactured in seven types differing in degree of unsaturation and viscosity. It is sold under the code letters GR-I followed by a number which determines the type.

Polymer Corporation Ltd. of Canada produces five types of crude butyl under the designation of Polysar Butyl, followed by a number.

These crude butyl polymers are sold to rubber manufacturers for use in preparing finished rubber products.

Processing

Butyl is compounded and vulcanized by the same general methods as natural rubber except for special precautions required by its low unsaturation. Carbon black is the customary filler and the fabricated article may be vulcanized by molding or in a steam pressure autoclave.

In addition to molded items of all types, the natural tackiness of butyl allows the use of this synthetic in conveyor and hose for handling strong acid solutions. It can also be calendered into sheets for use as linings in tanks, pipes, valves, etc.

Unlike natural rubber and the nitrile synthetics, additional sulfur will not increase the hardness of butyl. Variations in hardness are controlled by addition of carbon black and softeners. Butyl compounds can be made in the hardness range of 30 to 80 Shore Durometer A.

Properties

Vulcanized butyl compounds have good tensile strength and elongation, fair abrasion resistance and poor resiliency. The latter property improves considerably as the temperature is increased.

Rate of diffusion of gas through butyl is much slower than through natural rubber. This property leads to the use of butyl for automobile tubes and other items such as molded diaphragms, hose and tubing which contain air or other gases.

As a result of the low unsaturation of butyl, vulcanized compounds have excellent resistance to heat aging, ozone and attack by many chemicals.

Butyl may be used at service temperatures in the range of 200 to 240 F. Heat has a tendency to soften butyl over a period of time rather than harden it as happens with natural rubber.

The ozone resistance of butyl makes it very useful as a covering on wires and cables.

Vulcanized butyl compounds swell and deteriorate rapidly in contact with aliphatic and aromatic solvents in much the same manner as natural rubber. Unlike natural rubber, however, butyl will resist animal and vegetable oils and may be used in the presence of these materials.

Applications

Steam pressure hose made from butyl will outlast a natural rubber hose many times. This improvement has resulted in a trend to butyl hose for this application.

Chemical hose made of butyl is excellent for handling dilute nitric acid, strong sulfuric acid, concentrated formic and hydrofluoric acids.

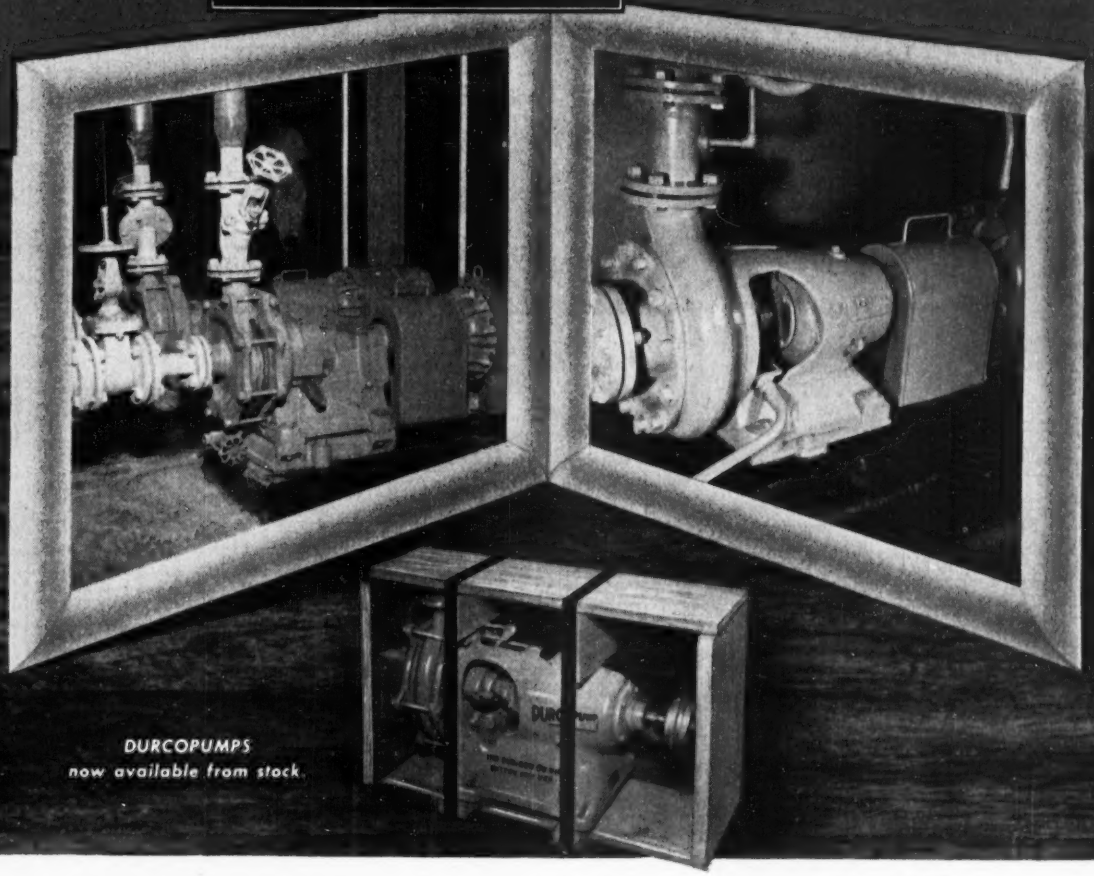
Conveyor belts with a butyl cover layer are being used very suc-

Continued: Text on page 246 ▶
Charts on page 242 ▶

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HERCULES

HERCULES POWDER COMPANY
PARLIN, NEW JERSEY



DURCOPUMPS
now available from stock

Durco has served Hercules for many years. The model 30 pumps pictured at the left *(above)* were installed about 1939, and are still in daily operation. The Model 40 pumps at the right *(above)* have been in continuous service for about eight years. Recently during Hercules' expansion program at Parlin, Durcopumps were again specified.

Hercules is a leading producer of cellulose products, resins, terpene chemicals, rosin and rosin derivatives, chlorinated products, industrial explosives, and many other materials.

The Duriron Company has been serving the world's leading manufacturers for more than forty years with process equipment for tough chemical services. Many leading companies have standardized on Durco equipment for long trouble-free life when handling severe corrosives.

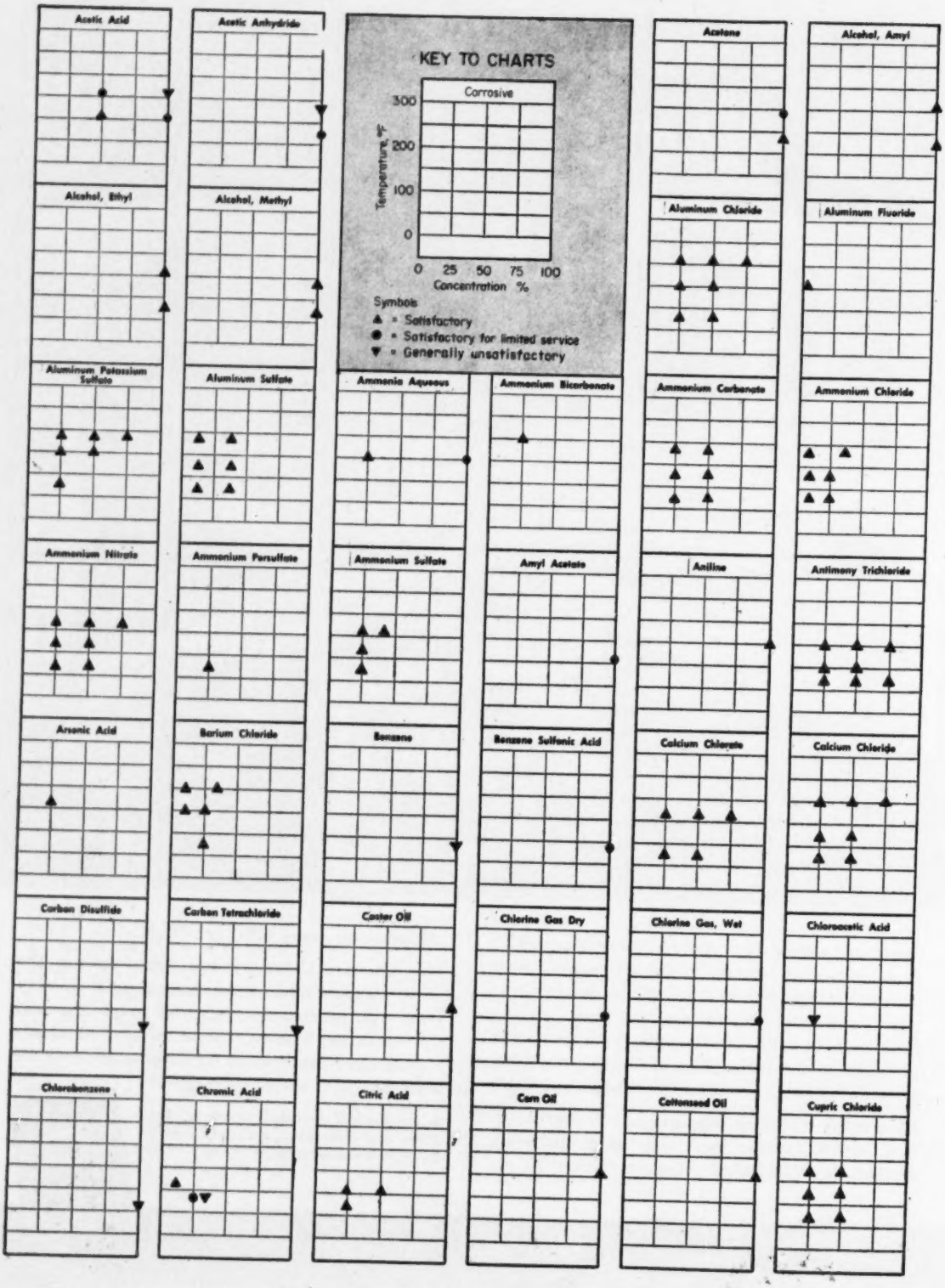
Durco Catalog 54 briefly describes Durco alloys and equipment, and lists detailed bulletins covering specific items.



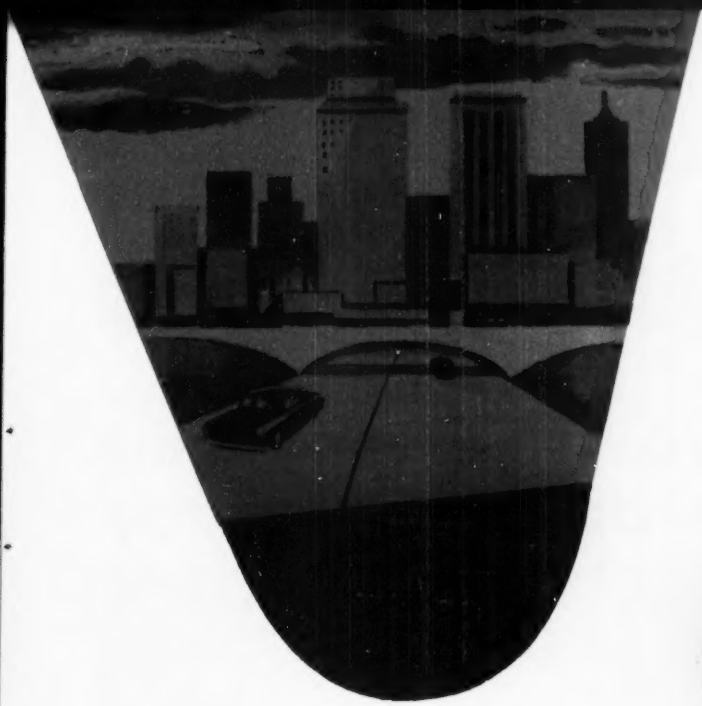
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

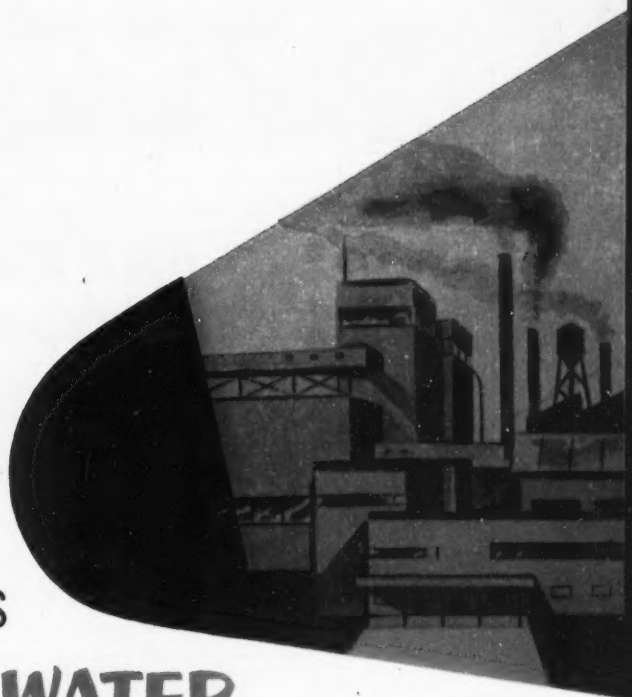
THE DURIRON COMPANY, INC. / DAYTON 1, OHIO

Corrosion Resistance of Butyl Rubber



CORROSION FORUM, continued on page 244





Our Cities and Industries are **THIRSTY FOR WATER** .....so is Agriculture



As more and more people move into private homes, water consumption climbs sharply. Without exception new production techniques in industry result in increased need for water . . . on our farms and ranches, the rapid growth of irrigated acreage means that more water is needed so that our food production can keep pace with population growth. America is truly thirsty!

Layne—the world's largest developers of ground water resources—knows most about these thirsts and how to satisfy them.

The knowledge and experience gained the world over is at your service. Your nearest Layne Associate Company can answer any question that relates to water—or write direct to:

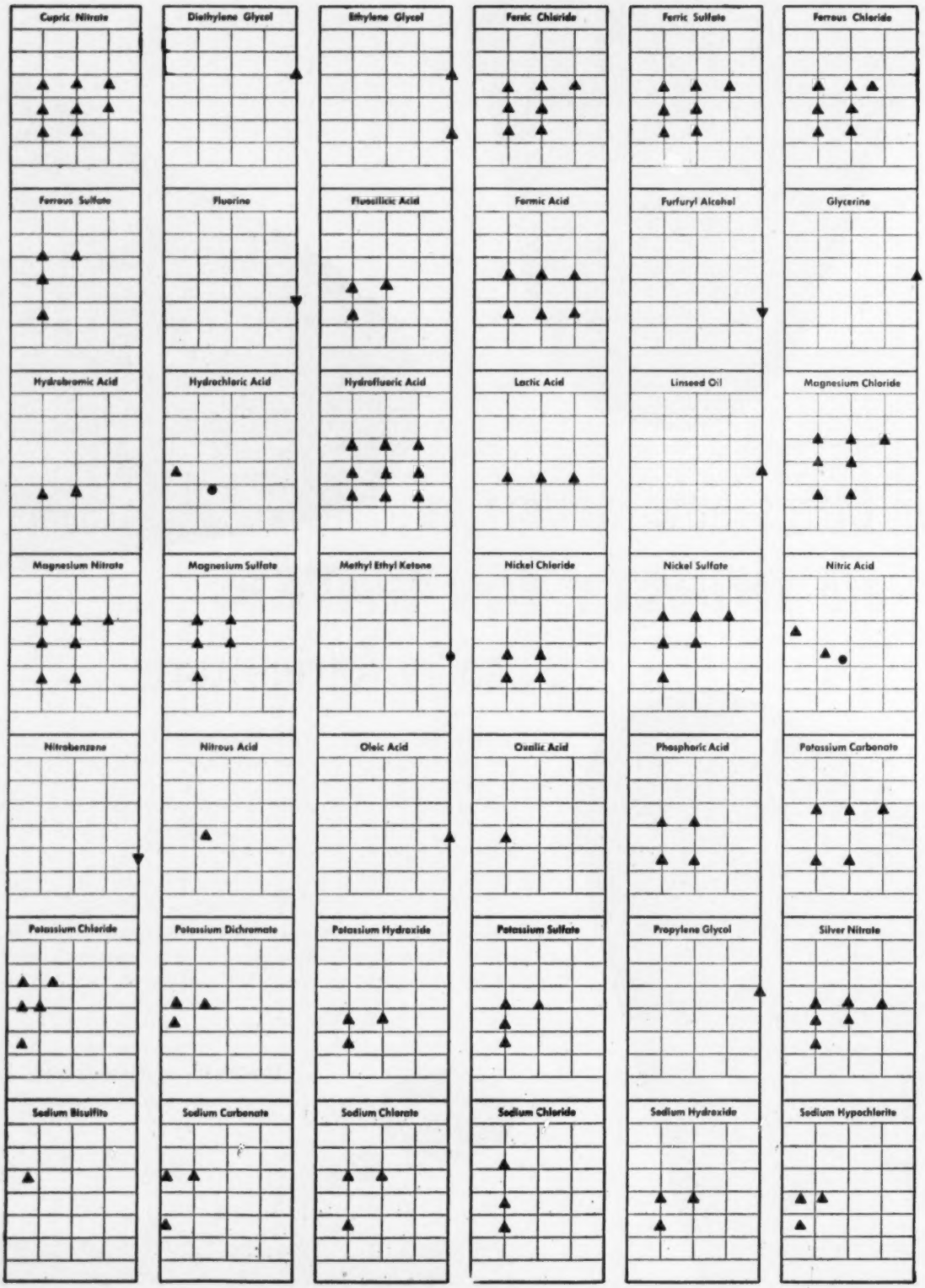


LAYNE & BOWLER, INC.
Memphis 8, Tennessee

Layne Associate Companies Throughout The World

Water Wells • Vertical Turbine Pumps
Water Treatment

Corrosion Resistance of Butyl Rubber



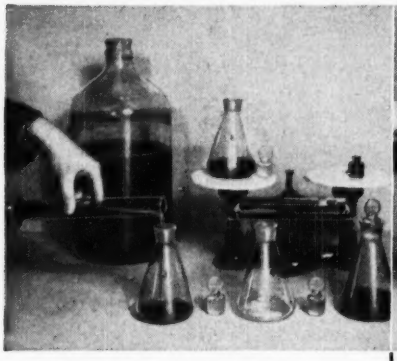
CORROSION FORUM, continued on page 246

DARCO

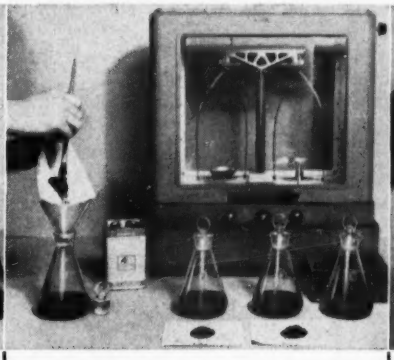
DARCO Digest

DARCO DEPARTMENT • ATLAS POWDER COMPANY
Darco General Sales Offices—60 EAST 42nd STREET, NEW YORK 17, N. Y.
ATLAS POWDER COMPANY, CANADA, LTD. BRANTFORD, CANADA

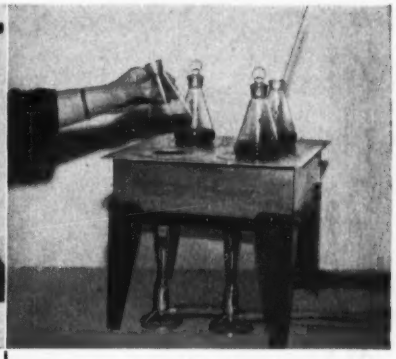
SIMPLE TESTS IN YOUR LAB DETERMINE DOSAGE OF DARCO ACTIVATED CARBON



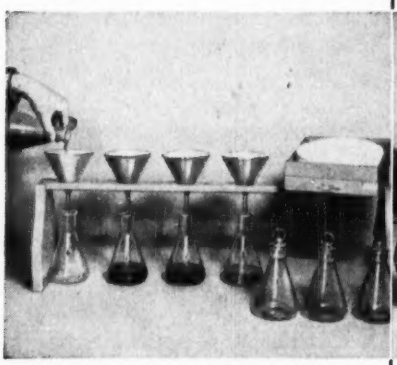
1 Measure or weigh out four 100-gram or 100-ml. samples of the liquid to be purified. Test sequence shown is for decolorizing; similar technique is used for other types of purification.



2 Add 0.5, 1.0, and 1.5 grams of Darco activated carbon to portions 1, 2 and 3 respectively. Portion 4 is your untreated control sample.



3 Agitate all samples by hand for about one-half hour, while heating on a steam bath to a safe temperature for your particular liquid.



4 Remove carbon by filtration—but collect sample only after filtrate becomes clear. You may need suction filtration for viscous liquids.



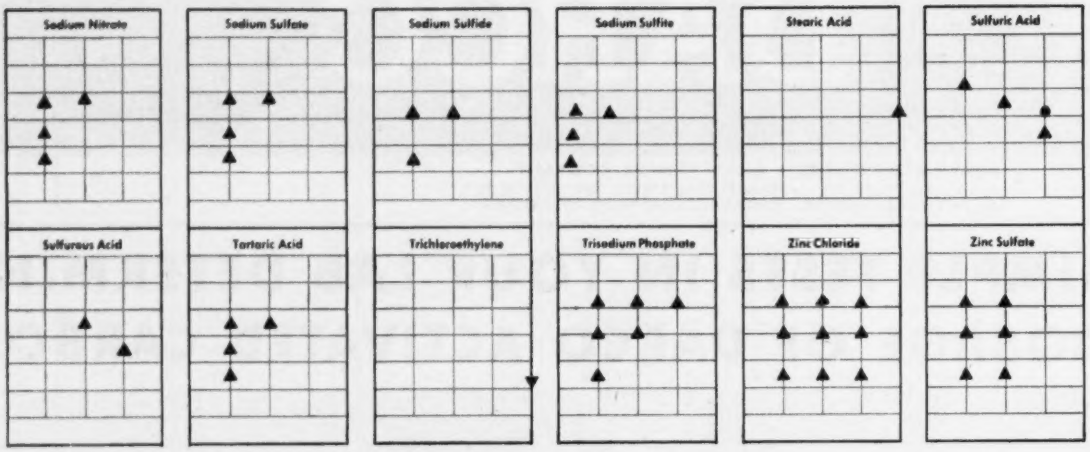
5 Determine residual color of filtrates and color of untreated sample by means of a suitable colorimeter.



6 By means of a Darcograph, plot the relation between color adsorption and carbon dosage . . . and read off the dosage for the residual color you require.

You can make these tests easily in your own laboratory, using equipment which you have on hand. By varying dosage ranges, temperatures, contact time, you can readily arrive at optimum treatment conditions. . . . We'll be glad to send you a Darcograph, instructions on its use, and samples of Darco for your testing. If you will outline your problem to us, we can suggest the most probable grades of Darco for your use, and thus save you testing grades we know, from experience, to be unsuited for your needs.

Corrosion Resistance of Butyl Rubber



Continued from page 240

cessfully to carry hot solid materials of various types. The good sunlight resistance of butyl is an added advantage for conveyor belts located out-of-doors.

Butyl coated fabrics can be used for many purposes around a chemical plant as protective coverings over bulk chemicals, etc.

Molded gaskets, seals, O-rings and diaphragms of various types are now made of butyl. Its excellent resistance to chemical attack, heat aging and low gas diffusion should be considered for particular applications of these molded items.

Butyl tank linings are being used to handle such strong acid conditions as 60% hydrofluoric acid at 180F., 30% nitric acid at 160F., 20% nitric acid at 180F., 70% sulfuric acid at 140F. and 50% sulfuric acid at 200F.

Linings of this type may be used in process and storage tanks of all types, railroad tank cars and tank trucks, as well as in pipe, fittings, valves, pumps, blowers and ductwork. The butyl sheet is prepared in a thickness of $\frac{1}{8}$ in. to $\frac{1}{4}$ in. by combining a sufficient number of $\frac{1}{32}$ in. calender plies. This avoids the possibility of forming air pockets within the butyl sheet.

The uncured sheet is then applied to the metal surface which has been cleaned and cemented. When the surface to be protected has been completely covered with butyl, the entire vessel is placed in a steam autoclave and heated under steam pressure to vulcanize the butyl and the adhesive cements. Butyl linings can be applied in the field provided the vessel being lined is of the proper design to allow the introduction of steam at 30 psi. approximately.

In considering tank lining applications, butyl extends the range of chemical conditions beyond those possible with natural rubber alone. It supplements natural rubber but does not replace it because there are many services for which natural rubber is a better choice.

One example is hydrochloric acid. Concentrated hydrochloric does not react with butyl to form a flexible protective surface film such as forms on natural rubber. As a result, hydrochloric will swell and penetrate butyl to an extent which depends on the temperature of exposure. This fact must be taken into consideration whenever butyl rubber is evaluated for hydrochloric acid service.

This rather brief description of the nature, method of manufacture, properties and applications of butyl rubber should serve to show the possibilities which can be expected from this relatively new type of synthetic rubber. Butyl rubber should be considered as an additional tool for corrosion control in the chemical industry.

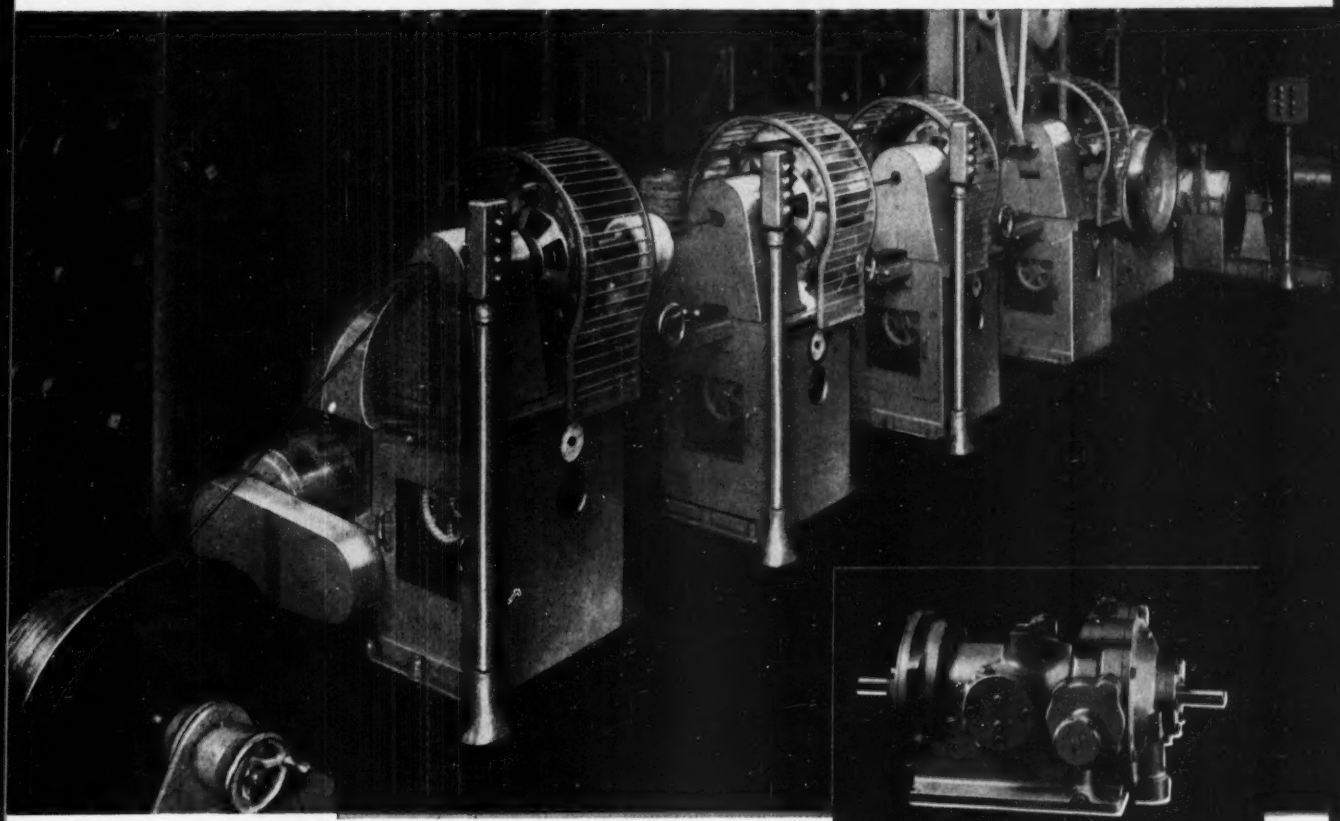
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For your information and convenience, here is a tabulation of the materials of construction which have been covered thus far in the current Corrosion Forum series:

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Asphaltic Mastics ..... May 1954
Butyl Rubber ..... Oct. 1954
Carbon & Graphite .... Sept. 1953
Cast High Alloys ..... Oct. 1953
Chlorimet 2 ..... Feb. 1954
Chlorimet 3 ..... Mar. 1954
Durimet 20—Carpenter 20 ..... Dec. 1953
Epoxies ..... Apr. 1954
Furane Cements ..... Dec. 1951
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High Silicon Iron ..... Jan. 1954
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Nitrile Rubber ..... Sept. 1954
Phenolic Cements ..... Jan. 1952
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Stainless Steels .... Apr.-Aug. 1953
Sulphur Cements ..... Feb. 1952
Tantalum ..... Apr. 1952
Unplasticized PVC ..... Nov. 1952
Worthite ..... Nov. 1953
Zirconium ..... Sept. 1953

Reprints of most of the above are available at 50 c. each (Hastelloys and Stainless Steels, 75 c. each.) Address Reprint Dept., Chemical Engineering, 330 W. 42 St., New York 36, N. Y.

MACHINE DESIGN AT WESTERN ELECTRIC



Its use of Oilgear Fluid Power

Western Electric Company, manufacturing unit of the Bell Telephone System, originates, designs and builds many of the special machines it uses in its own manufacturing processes. It also maintains unceasing pressure to improve upon machines already in operation, for optimum performance, for better product, for lower costs, for freedom from trouble.

Its use of Oilgear Fluid Power Drives and Transmissions has been increasing because, in the words of their engineers, Oilgear enables them among other things to synchronize many machine components easily and economically. A good example of all these points is the "short haul" video cable wrapping machine pictured above.

This machine was designed and built by the company's own men some years ago. For optimum performance, the speed of the heads should be easily and independently variable and the direction of rotation instantly changeable because the lay and pitch of the wrappings must be varied according to the requirements of the run. Moreover, the inside contour of the tube formed by the wrapping should be smooth and uniform so as to avoid setting up echo waves that interfere with transmission and vitiate signal strength.

Because of these requirements, a new drive was installed something over 4 years ago. A line shaft drives five Oilgear Fluid Power Transmissions, one at each machine head and the capstan.

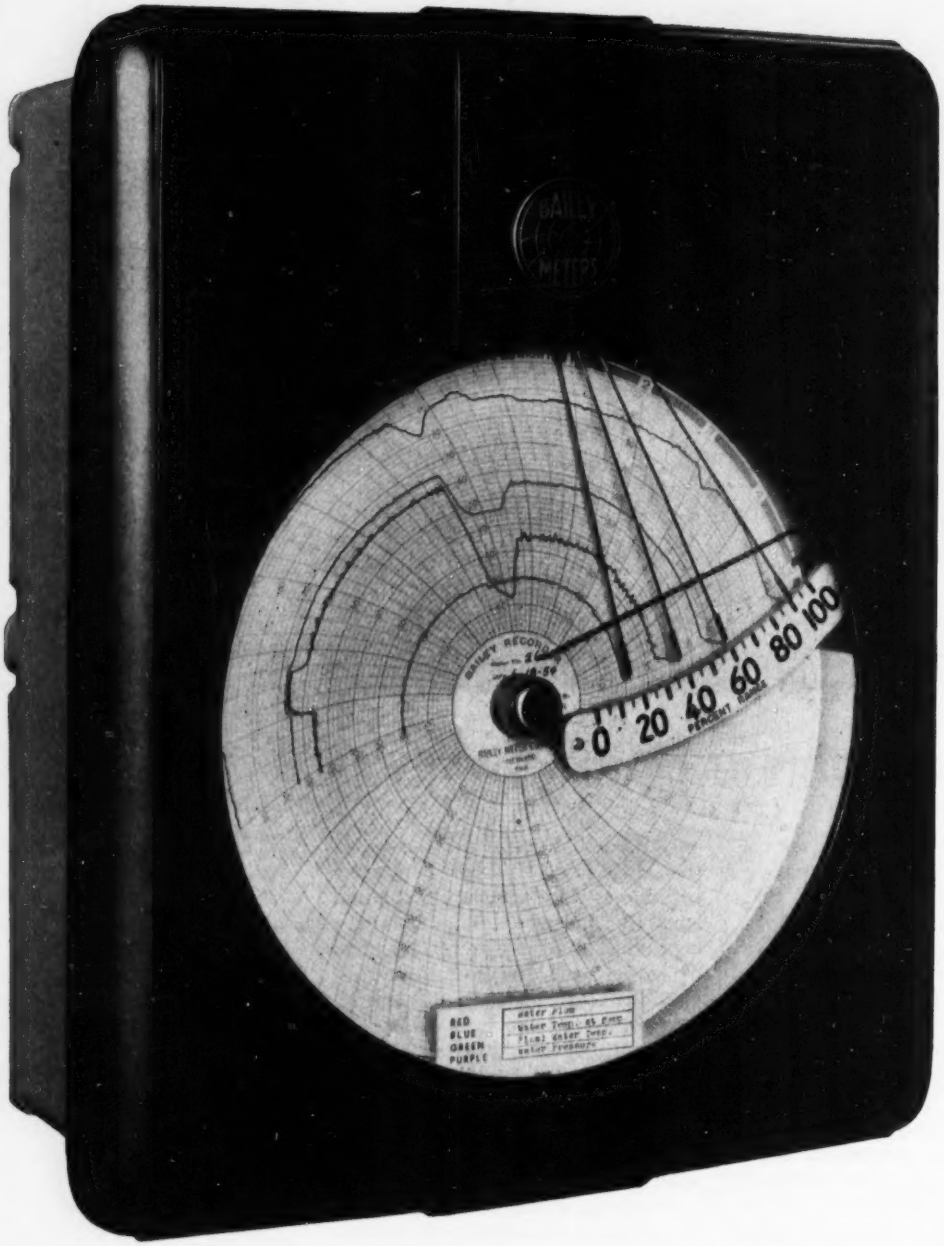
The results were these: uniformity and control of tension are so good, the machine runs at 4 times its former machine speed; it is easy to vary speed and direction of rotation of each individual head; eccentric heads gave way to concentric heads, and supply spools are now loaded to full capacity instead of ¼th to ⅛th as before; the machine is stopped less frequently for loading. Maintenance on the former drive was involved and frequent—on the Oilgear equipment it has been simple and negligible.

There is some reason to suspect that Oilgear Fluid Power with its wide range of advantages may solve some of *your* machine design problems and make the results very pleasing and profitable. Why don't you really find out? THE OILGEAR COMPANY, 1579 West Pierce Street, Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

Announcing the New Bailey

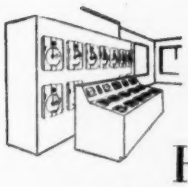


The New Bailey Recorder provides continuous chart records of any four measured variables:

% combustibles	density	flow	pH	ratio	speed
combustion	differential	liquid level	position	smoke density	temperature
conductivity	draft	% oxygen	pressure	specific gravity	vacuum

Recorder for—

Pneumatic and Electric Transmission Systems



Here is a panel-mounted recorder that offers new versatility never before available in a single instrument. Its unique interchangeable-unit design permits recording up to four measured variables, regardless of their nature or the location at which they are measured.

Individual plug-in type pneumatic or electronic receivers—and corresponding integrators—are interchangeable in the four identical frame-slots, permitting any combination of four pneumatic or electronic signal receivers, *or any two receivers and their two integrators.*

For the first time you can record four telemetered measurements on a single 12-inch circular chart—with a minimum of first cost and installation expense, and a maximum of operating economy. Low cost multi-purpose components permit fast and easy adaptation to new or changed process cycles.

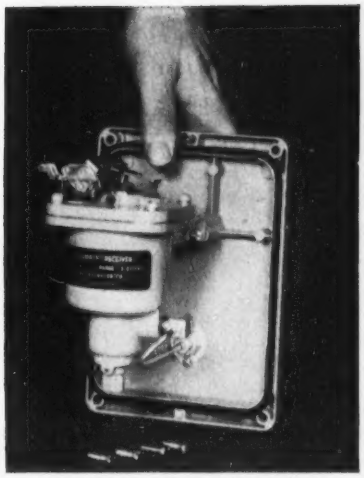
Check These Outstanding Advantages

Extreme Flexibility of Application is provided through the use of pre-calibrated plug-in type units—pneumatic or electronic—to record any measurable variables, in any combination. For example, you can "plug-in" pneumatic receivers along with electronic receivers to record up to a total of four variables on the same chart. Or your recorder casing can accommodate two integrators and their two corresponding recording receivers for rate of flow.

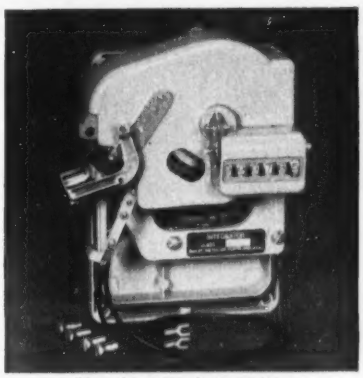
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Faster, Easier Ordering from Stock results from the unique standardized unit design. You can select any combination of recording receivers to fit your needs, by reference to simplified catalog specifications, and receive shipment without the delays ordinarily resulting from custom assembly. Complete interchangeability of plug-in type components simplifies stocking of spare units.

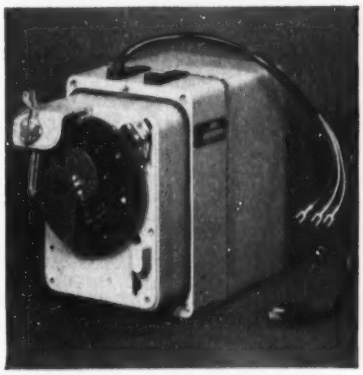
G34-2



Plug-in type pneumatic receiver



Plug-in type integrator



Plug-in type electronic receiver

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METER COMPANY
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Controls for Power and Process

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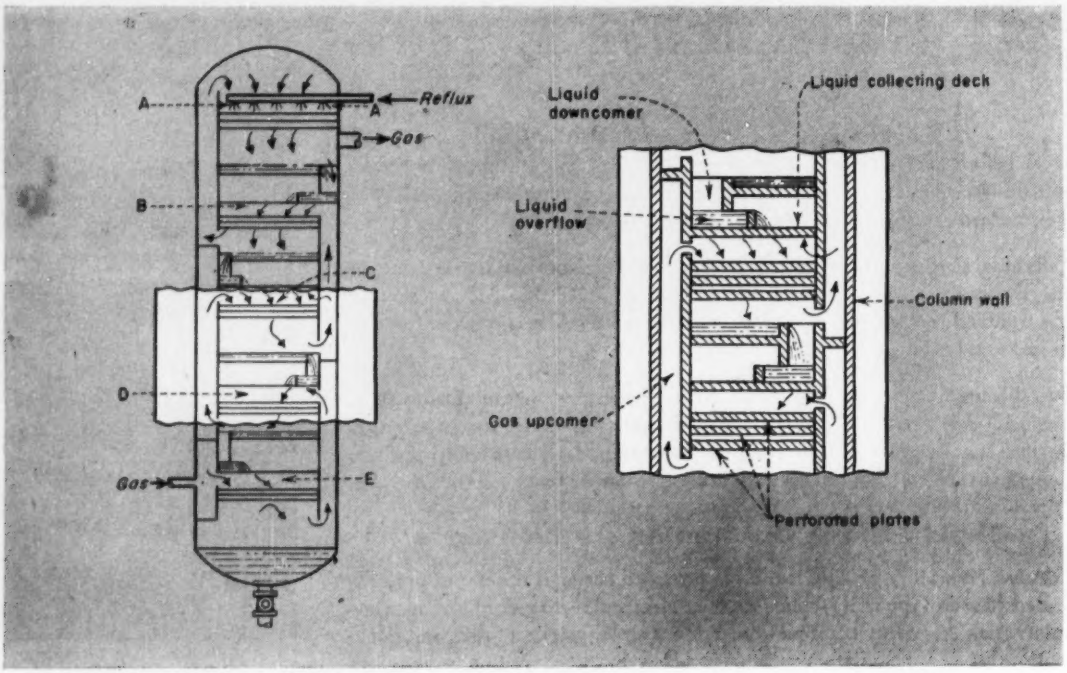
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City_____ Zone____ State_____

NEW EQUIPMENT PATENTS . . .



Novel Switch in Gas-Liquid Contacting

Concurrent downward flow of gas and liquid gives this contacter an edge over conventional types when it comes to higher capacities and lower pressure drops.

Countercurrent contacting of a gas and liquid is old hat. But here's a novel column design which features a switch—concurrent downward flow of gas and liquid.

Koch Engineering's patent describes several variations on this basic new design. One of these—primarily useful for contacting relatively non-condensable gases with liquids—illustrates how the theory is put into practice.

▶ **Sectioned Column**—The new column is made up of a number of gas-liquid contacting sections or stages—A, B, C, D, E. Gas enters at the bottom of the tower (Section E).

In passing down through a set of perforated plates, the gas comes in contact with liquid rained down from a perforated liquid-distributing plate above. Liquid feeds to the distributor plate from an unperforated liquid-collecting deck, liquid downcomer and overflow.

A liquid seal on the downcomer prevents gas from flowing up through perforations in the distributing plate. Gas rises through an upcomer into the next section (D); and the process is repeated.

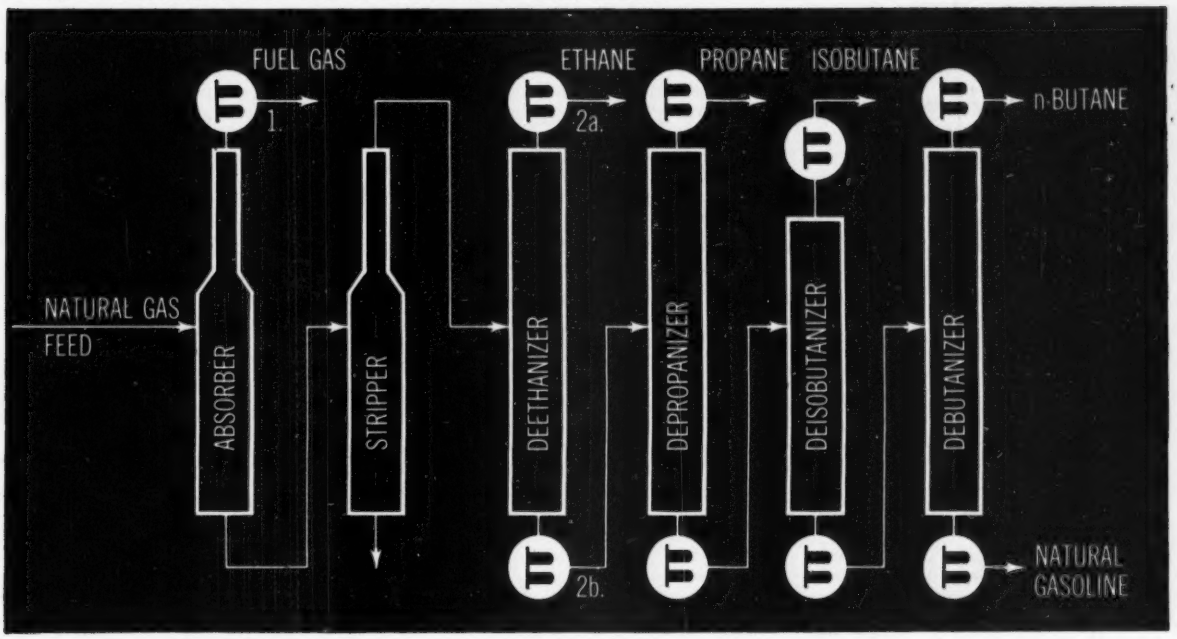
As you can see, overall flow of gas and liquid is still basically countercurrent. But the flow in each stage of the column is concurrent.

▶ **Features**—This novel apparatus offers several advantages over the conventional type of gas-liquid contacter:

- Eliminates entrainment problems.
- Handles greater quantities of both gas and liquid.
- Contacts either gas or liquid at low rates.

In two succeeding patents (U. S. 2,678,200 and 201) the inventor describes improvements in his now-famous Koch Kascade gas-liquid contacter.—**U. S. 2,678,199 by Fred C. Koch to Koch Engineering Co., Inc.**

TRUE CONTROL BEGINS WITH ANALYSIS...



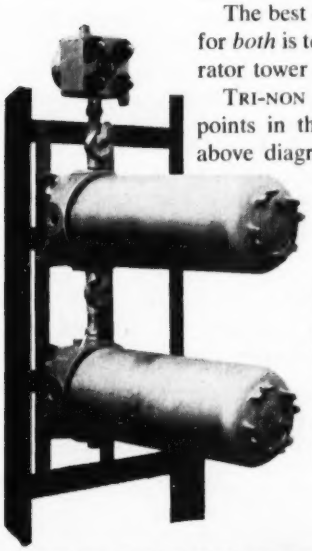
TRI-NONs® Up Efficiency in Light Hydrocarbon Separations

It is simple to produce high product purity in light hydrocarbon separations, but only at the expense of percent recovery, or to obtain 100 percent recovery at a sacrifice of purity. But operating *profit* depends upon the ability to obtain a maximum of both product purity and percent recovery. Close control of the process environment: temperature, pressure, flow rate, is not sufficient since environmental controls do not give any indication of stream composition.

The best way to insure maximum returns for *both* is to analyze continuously the separator tower overhead and bottoms.

TRI-NON Analyzers installed at critical points in the process, as indicated in the above diagram, monitor the concentration of the important components. Analyzer 1 measures the concentration of hydrocarbons heavier than methane in the absorber overhead to check absorber efficiency. Analyzers 2a and 2b indicate ethane purity and ethane loss in the bottoms. The remaining analyzers perform the same functions on the other towers. The data provided permit operation at the most profitable level at all times.

In light hydrocarbon separation as well as in practically all other chemical processing—True Control Begins with Analysis. Perkin-Elmer's continuous infrared analyzers can provide the ANALYTICAL CONTROL essential for most profitable operation. Perkin-Elmer engineers can show you how analytical control can be applied to your process.



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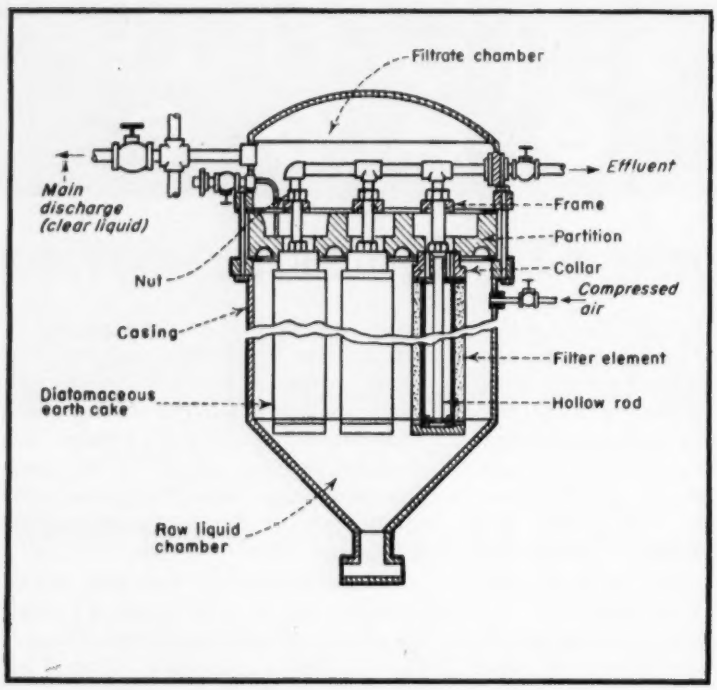
The new machine consists of an upper and lower launder, separated by a riffle board. Each launder houses a screw conveyor.

▶ **Upper Launder**–Crushed ores, together with water, feed to a hopper in one end of the upper launder. An oscillating screen in the hopper separates coarse material from the fines. The latter fall through the screen into the upper launder.

Here the screw conveyor agitates the ores and water, causing heavier values to settle to the launder bottom–between the riffles. Tailings pile up at the end of the launder; excess spills over the end plate.

As soon as sufficient ore segregates, feeding stops and a gate opens. Rotation of the screw conveyor expels the tailings from a chute.

▶ **Lower Launder**–Next, the riffle board opens. Concentrates between the riffles are scraped off and fall into the lower launder. The screw conveyor in this section ejects the values through the launder's open end–and into collecting pans.–**U. S. 2,680,518 by William A. E. Hult.**



Filter Discharges Without Opening

Discharging a filter cake without opening the filter case is not new (e.g. rotating leaf filter), but here's a variation which is.

▶ **Filter Construction**–The new design consists of an inverted candle-type filter. As shown, a horizontal partition divides the filter into two sections–a lower raw liquid chamber and an upper filtrate chamber. Several filter elements, each consisting of a hollow tubular screen, hang from the partition.

Passing up through the collar, a hollow tubular rod (fixed to the bottom of each filter element) supports the filter with a frame and nut. The bottom of the rod is open; the top hooks up to an effluent discharge line. This line, in turn, ties into the main clear liquid discharge line (connection not shown).

Raw liquid (containing a filter aid such as diatomaceous earth) (1) feeds into the lower chamber, (2) passes up through the filter elements into the upper chamber, (3) then exits through the main discharge line.

▶ **Compressed Air Admitted** – When the filter cake is sufficiently thick or the filtration rate drops off sharply, compressed air is admitted into the raw liquid chamber. The air forces raw liquid through the cake until the liquid level is below the top of the cake.

Air passing through the cake forces liquid in the filter elements out through the tubular supporting rods, then through the effluent discharge line.

Opening a bypass valve around the pump (not shown) allows the air pressure to blow residual liquid (in the lower chamber) out through the bottom fitting–and back to the raw liquid supply tank.

Meanwhile, the pressure differential keeps the filter cake intact on the filter elements. When the filter is empty, the bypass valve is closed.

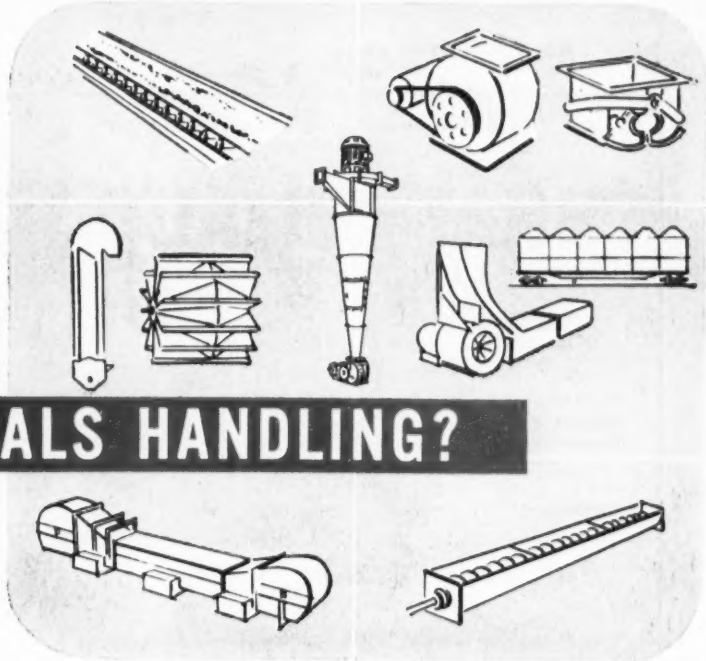
▶ **Purging The Cake**–Next, water flows into the lower chamber–against the air pressure. As soon as the water overflows through the main discharge line, the air valve is closed.

The system is then regulated so that water flows back through the filter elements, throwing off the cake. Water and cake exit from the bottom of the filter.–**U. S. 2,681,153 by Henry N. Armbrust to Proportioneers, Inc.**

This department is designed to keep you abreast of the latest developments in chemical equipment and processes. Any patents may be ordered from the Commissioner of Patents, Washington 25, D. C. The cost: 25 cents.

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BULK MATERIALS HANDLING?



AIR

Outstanding examples of the great savings made possible by pneumatic conveying systems are found in the Sprout-Waldron Pneu-Vac. This modern, negative-pressure system handles granular, pulverized, and flaky materials without passing them through the fan. Mechanical friction and exterior dusting are eliminated. The unit is self-cleaning. It cools, heats, aerates, or dries. There are few moving parts. As a result, Pneu-Vac pays in many ways—

99.96% material recovery . . . no handling losses . . . increased production . . . greater safety . . . low maintenance . . . no product intercontamination . . . no fan wear . . . elimination of exterior dust . . . improved working conditions . . . small space requirements.

SCREW

Screw conveyors offer advantages for two types of jobs: (1) The straight-line horizontal conveying of a wide range of bulk materials over moderate distances. (2) The vertical lifting of non-fusing materials to limited heights. Sprout-Waldron vertical and horizontal screw conveyors are extremely low in maintenance and moderate in power requirements. Available in conventional helicoid, continuous sectional, and sectional types.

BELT

Belt conveyors are unequalled in speed and economy for long-distance conveying of bulk materials horizontally and up inclines. Sprout-Waldron offers sound guidance on belt conveying applications and a full line of pulleys . . . and is the exclusive manufacturer of the famous Belt-Saver Pulley that lengthens belt life up to 400%.

BUCKET

Bucket elevators use less power, are usually lowest in first cost and maintenance expense. However, they cannot be made as self-cleaning and contamination-proof as other materials handling systems. Sprout-Waldron offers bucket elevators in bucket sizes from 3" x 3" to 30" x 16" . . . wood, stainless, carbon steel, and aluminum . . . chain or belt, high speed or conventional.

FEEDERS

To provide the greatest possible savings in applications calling for rotary vane feeders, Sprout-Waldron offers you three advantages: (1) The most extensive line to be found anywhere. (2) Years of experience gained through pioneering in this specialized field. (3) The simplest, sturdiest and easiest-to-maintain feeders available.

Whichever type of conveying equipment fits your needs, you'll get greatest savings with a Sprout-Waldron installation. Sprout-Waldron solves your problems with a vast background of experience, complete lines of equipment and unique *"adaptioneering"* methods. Let us advise you without cost or obligation. *Please write for details.*

YOUR INVESTMENT PROTECTED

Our 88 years of service to industry is good assurance that you can obtain parts and service for the life of your Sprout-Waldron equipment.

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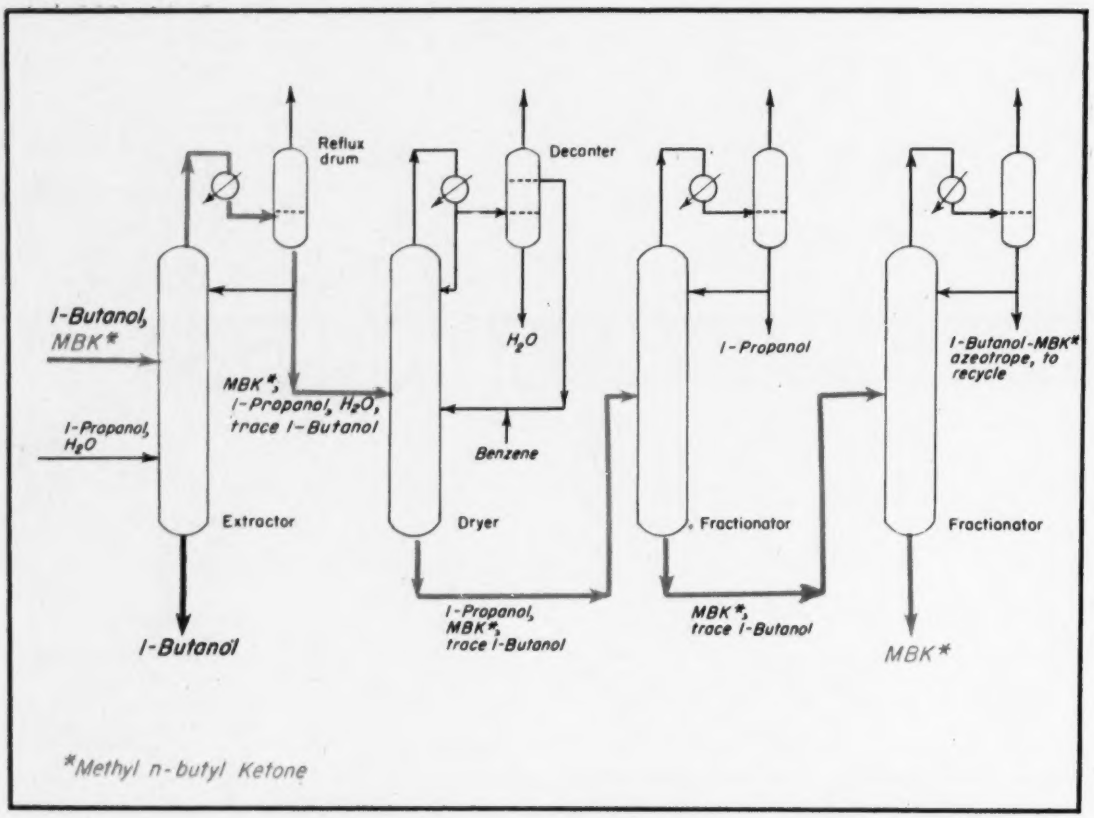
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How You Can Separate Alcohols from Ketones

Azeotropic distillation of an alcohol-ketone mixture with 1-propanol and water highlights a new process for recovering synthesis products.

The recovery of alcohols and ketones from synthesis processes (Fischer-Tropsch and others) presents a problem. Products come off as azeotropes with water, making ordinary fractional distillation impossible.

But Stanolind has come up with a new process which may obviate this difficulty. In particular, it deals with the separation of 1-butanol and methyl n-butyl ketone by azeotropic distillation with a mixture of 1-propanol and water.

▶ **Propanol Extraction**—First step in the new process is the feeding of two mixtures—one, 1-butanol and methyl n-butyl ketone; the other, 1-propanol and water—into an extractor. Enough propanol and water (entering below the alcohol-ketone feed point) is added to form an azeotropic mixture with substantially all the methyl n-butyl ketone in the charge.

A stream of dry, almost pure 1-butanol leaves the bottom of the column. At the top, the propanol-water-ketone azeotrope (plus traces of butanol) exits to a cooler, then to a reflux drum.

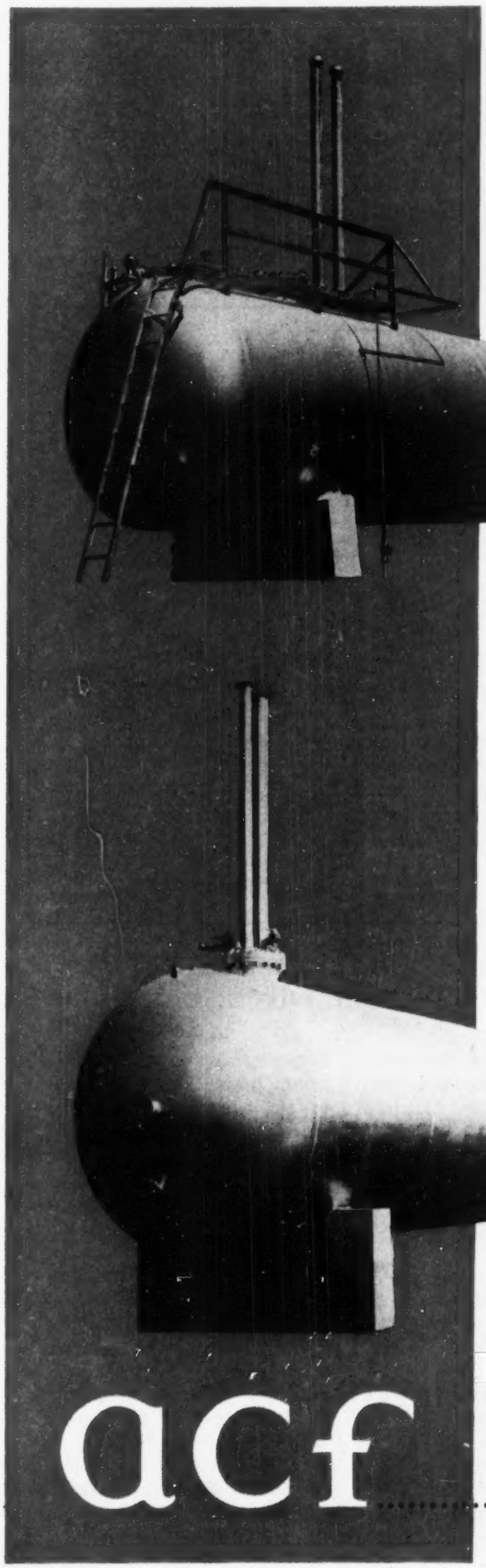
▶ **Distilling With Benzene**—Part of the overhead returns to the top of the column, the rest goes to a dryer where it is fractionally distilled in the presence of benzene.

Overhead from the dryer—a benzene-propanol-water azeotrope—flows through a cooler, then divides into two streams. One returns to the top of the dryer, the other collects in a decanter.

Here two phases separate—one, aqueous; the other, organic. The aqueous phase, containing traces of organic material, goes to a stripper which removes the organics.

The organic phase (mostly benzene and propanol) returns to the dryer at a point somewhat below the feed point of the propanol-water-ketone azeotrope. Makeup benzene is supplied, as required.

The flow rate of benzene is regu-



which is the QUALITY TANK?

Both tanks look alike, but just ask the owner of an ACF-built tank! His experience over the years best illustrates the *extra quality* built into every tank—quality you get at a competitive price!

Here are just a few facts on ACF quality: After the tank seams are welded, *every inch* of seam is X-ray inspected. But even this isn't enough to measure up *to* ACF's *traditional* standards! Each U-68 tank is then *stress-relieved* to remove the stresses set up in metal by welding—providing an *added safety factor!*

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lated so that (1) all the water appears in the column overhead and (2) exiting bottoms are benzene-free.

A dry stream of propanol, ketone and traces of butanol flows from the bottom of the dryer to a propanol fractionator. Pure, dry propanol comes off as overhead.

▶ **Final Fractionation**–Ketone contaminated with traces of butanol leaves the bottom of the fractionator, flowing to a second fractionator.

Here, butanol contaminant–in a binary azeotrope with methyl n-butyl ketone–comes off as overhead which may be recycled to the extractor. Fractionator bottoms yield a stream of substantially pure methyl n-butyl ketone.–**U. S. 2,681,882 by Howard Grekel to Stanolind Oil and Gas Co.**

Alkalinity Curbed in New Pigment Formulation

Good news for pigment producers. A new way to make calcium-silicon oxide pigments reduces their alkalinity–thus giving promise of their wider acceptance as filler for rubbers and plastics.

Until now, these pigments have had limited use because of their high calcium content and alkalinity. Their agglomerates resisted breakdown in milling operations.

The new process features the reaction of aqueous sodium silicate and calcium chloride solutions with CO_2 to form a product consisting of small particles–20 to 50 millimicrons in diameter. These particles form agglomerates which break down when milled.

▶ **Reaction Variables** – Several factors affect the success of this simple reaction:

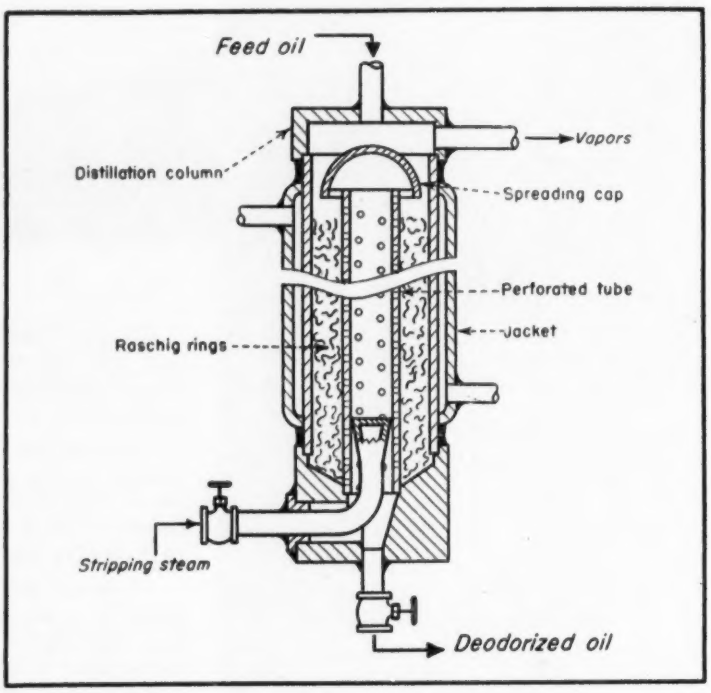
• Sodium silicate should contain SiO_2 and Na_2O in the ratio of 3.25:1. The preferred weight ratio of SiO_2:CaO is 1:1.

• Calcium chloride can be replaced by any calcium compound that's slightly soluble in alkaline solutions.

• CO_2 can be replaced by any acid that will not form a calcium salt less soluble than the silicate. Enough acid must be added to maintain a pH of from 8.5 to 10.5.

• Reaction temperatures should be no lower than 60 C. Reaction time varies with temperature–e.g. 8 hr. at 65 C., 2 hr. at 85 C.

After the pH stabilizes, the solution is filtered or centrifuged to separate the product.–**U. S. 2,679,463 by G. B. Alexander and R. K. Iler to E. I. du Pont de Nemours & Co.**



Deodorizing Vegetable Oils

Savings in time and money are the claims of a new process for deodorizing degummed and bleached vegetable oils.

Like conventional methods, the new process involves a low-pressure steam distillation. But the similarity ends here. For the improved procedure affords:

• Faster reaction time–10-48 minutes instead of 1-8 hours.

• Lower steam consumption–0.05-0.20 compared with 1-4 lb./100 lb. oil per hr.

• Lower reaction temperatures –190-250 F. rather than 400-475 F.

• Lower pressures–20-60 microns in lieu of 4-20 mm. Hg.

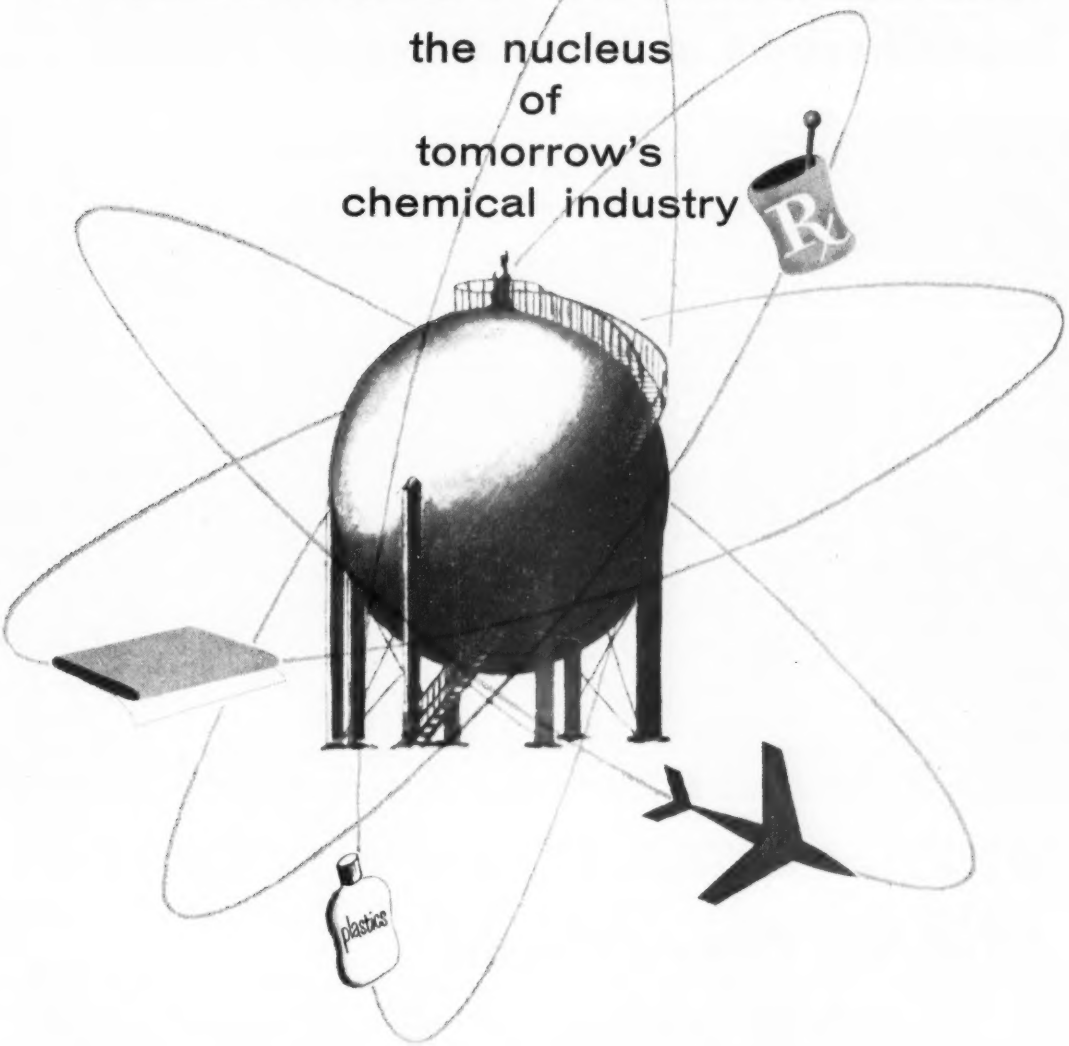
▶ **How It's Done**–First step in the continuous process consists of degassing the oil to remove molecular oxygen. Stripping agents (alcohol, hexane, heptane) can then be added to facilitate removal of volatile constituents.

Next, the oil flows to a column maintained at the prescribed temperature and pressure. Feed flows over the spreading cap and down through the packed annular section. It may, because of its impeded flow, also run through the perforated tube and down the inner wall.

Total holding time in the column (regulated by the flow rate of feed) is 3-10 minutes. Vapors exiting from the column top go to a condenser or other collector. Bottoms are deodorized oil.–**U. S. 2,674,609 by R. E. Beal and E. B. Lancaster to United States of America (Sec'y. of Agriculture).**

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Many have predicted that by 1975 there will be 54 billion pounds of petrochemicals produced yearly—360 percent over the 1950 figure. And it is agreed that this poundage will represent better than 50 percent of the total chemical production. In fact, petrochemicals will form the nucleus of our future chemical industry.

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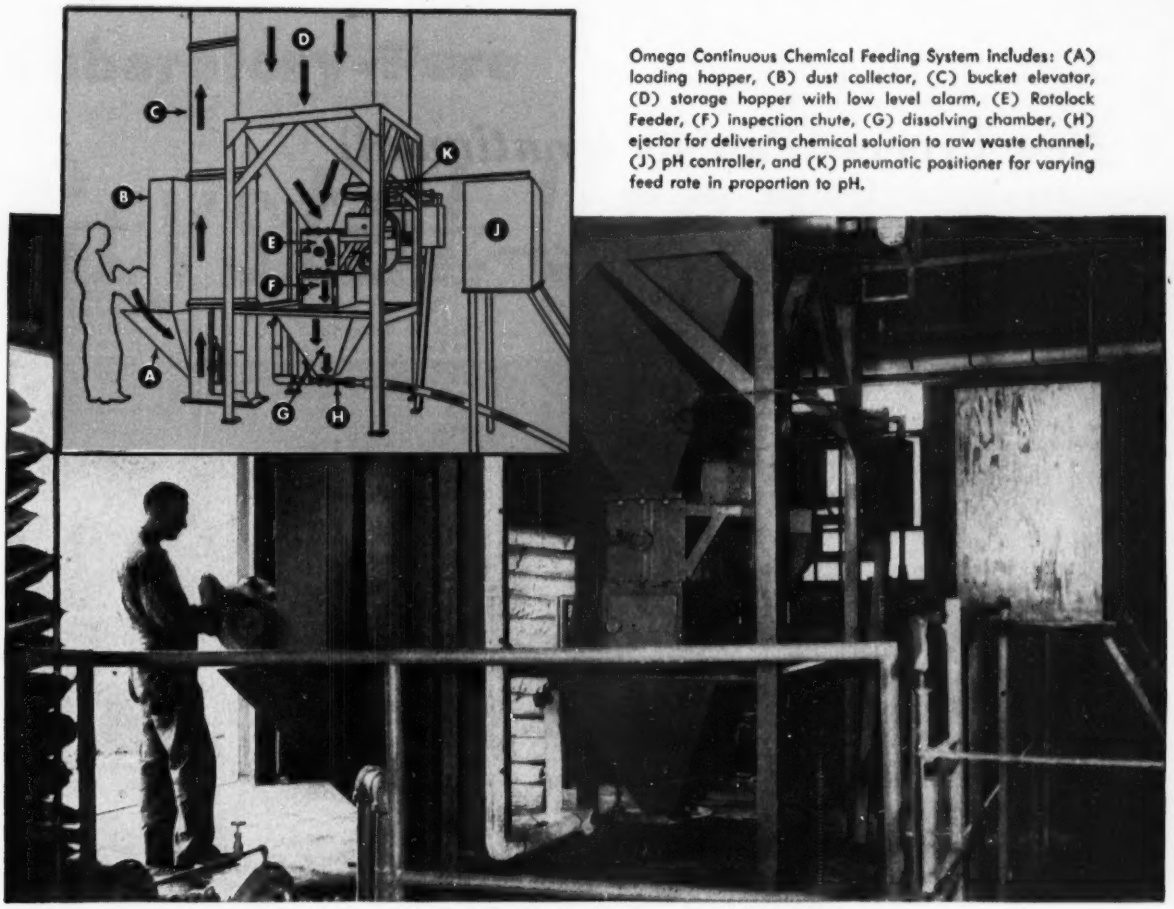
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Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Distillation	Entrainment reduction in bubble cap towers	Standard Oil Development Co	2,681,218
	Gas-liquid contacting tray	Koch Engineering Co., Inc.	2,681,219
	Spray-grid tray column with fluid distribution or draw-off tray	Shell Development Co.	2,682,394
	Molecular still	Atomic Energy Commission	2,682,451
	High vacuum distillation and drying system	Kraft Foods Co	2,682,499
Drying	Apparatus for treating fibrous sheets with superheated steam or vapors	Julien Dungler	2,682,116
Extrusion and molding	Combination extrusion-injection molder	Harold Corbett	2,680,880
	Compression molder	Stanley G. Mock	2,680,881
	Injection molder	H-P-M- Development Corp.	2,680,883
	Molder for plastic articles	Vinl-Cast, Inc.	2,681,472
Filtration	Cell-type filter	Earl G. Gunn	2,682,953
	Multiple-leaf rotary filter	Frank V. Burman	2,682,954
Fluid and particle flow	Elevator for contact material	Sun Oil Co.	2,681,833
	Liquid-granular solids contacter	Houdry Process Corp.	2,683,109
Gas absorption	Radial spray-type gas and liquid scrubber	Joseph van Ackeren	2,681,799
Heat transfer	Pebble heater	Phillips Petroleum Co.	2,676,909
	Method and apparatus for storing heat	Maria Telkes	2,677,243 & 2,677,367
	Turbulence strip for heat exchanger tubes	Young Radiator Co.	2,677,394
	Built-up plate heat exchanger with spiral flow	Alvin Hock, Sr.	2,677,531
	Tangentially finned heat exchange tube	Andre Huet	2,677,532
	Rotary air preheaters	Jarvis C. Marble et al.	2,681,208–9
	Pebble heater	Phillips Petroleum Co.	2,682,497
	Heat exchanger for hot air furnaces	W. Butler and S. F. Pride	2,683,024
Liquid-liquid contacting	Contact tower	Socony-Vacuum Oil Co., Inc.	2,681,269
	Resolution of water-in-oil emulsions with an electric treater	Petrolite Corp.	2,681,311
	Multistage continuous liquid-liquid contacter	Atomic Energy Commission	2,682,452
	Mixer-settler contacter	Atomic Energy Commission	2,682,453
Solid-gas separation	Recovery of water-soluble materials suspended in hot gases	Research Corp.	2,681,121
	Energizing system for electrostatic precipitators	Research Corp	2,681,122
	Cyclone separator	Hendrick van der Kolk	2,681,124
	Removing dust and condensable vapors from gases	Standard Oil Development Co.	2,681,125
	Gas filter	U. S. Sec'y. of War	2,681,155
	A.c. ion filter for electrical precipitators	Research Corp	2,682,313
	Wet bottom precipitator	Research Corp.	2,682,314
	Gas filter	Mine Safety Appliances Co.	2,682,315
	Air purifier	Hans J. Kaufmann	2,682,316
Solid-solid separation	Classification of solids	Charles E. Warsaw	2,681,146
Storage	Storage of liquefied gases	Air Reduction Co., Inc.	2,682,154

. . . And New Process Patents

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No. . .
Carbon	Activated carbons from tar pitches	Allied Chemical & Dye Corp.	2,681,318
	Treating high pH furnace carbon black	Phillips Petroleum Co.	2,682,448
	Carbon black production	United Carbon Co., Inc	2,682,450
Catalysts	Control of catalyst hydration	Standard Oil Development Co	2,681,374
	Regeneration of phosphorus-molybdenum oxide catalyst	The Distillers Co. Ltd.	2,683,122
Detergents	Production of alkylated aryl sulfonate detergents	Shell Development Co.	2,676,185
Dyes	How to mix, vacuum dry and pulverize an ortho-cellutone dye	Struthers Wells Corp.	2,677,504
Fats and oils	Wrinkling oils from polymerized nonwrinkling bases	New Wrinkle, Inc.	2,676,918
	Purifying monoglycerides from superglycerinated refined fats	Swift & Co.	2,682,550
	Fatty oils recovery	The Chemical Foundation, Inc	2,682,551
	Refining phosphatides-containing vegetable, marine and animal oils	The De Laval Separator Co	2,683,155
Fertilizers	Digestion of phosphate rock	Cannac Research & Development Co	2,683,075
Fuels	Combustible gas manufacture	William W. Odell	2,681,273
	Water gas from gasified carbonaceous solids	Pittsburgh Consolidation Coal Co.	2,682,455–8
Gases	Air separation	The Heat-X-Changer Co., Inc.	2,682,157
	Air separation	Julian Langer	2,682,162
	Continuous removal of H_2S from gas	Humphreys & Glasgow Ltd.	2,682,444
	HCN and acetylene production	Phillips Petroleum Co.	2,682,447
Glass	Annealing glass	Ovide Wambreuze	2,669,068
	Annealing glass	Emhart Mfg. Co.	2,669,069–70
Hydrocarbons	Dehydration of liquefied petroleum gas	Standard Oil Development Co.	2,671,034
	Para-xylene separation	Standard Oil Development Co.	2,672,487
	Catalytic decomposition of hydrocarbons	Standard Oil Development Co.	2,672,490
	Recovering shale oil	Phillips Petroleum Co.	2,673,177
	High molecular weight aromatics removed from high-boiling oils	Standard Oil Development Co	2,681,301
Inorganic chemicals	Recovery of sulfur dioxide in waste gases	Texas Gulf Sulphur Co.	2,676,090
	Hydrocarbon conversion with aluminum chloride-hydrocarbon complex catalysts	Standard Oil Co. (Ind.)	2,677,988
	Preparation of uranium tetrafluoride	U. S. Atomic Energy Commission	2,674,518



Omega Continuous Chemical Feeding System includes: (A) loading hopper, (B) dust collector, (C) bucket elevator, (D) storage hopper with low level alarm, (E) Rotolock Feeder, (F) inspection chute, (G) dissolving chamber, (H) ejector for delivering chemical solution to raw waste channel, (J) pH controller, and (K) pneumatic positioner for varying feed rate in proportion to pH.

CONTINUOUS WASTE NEUTRALIZING THE EASY, OMEGA WAY

WOLVERINE TUBE Division of Calumet & Hecla, Inc., at Decatur, Ala., uses this Omega Continuous Chemical Feeding System to neutralize acid pickle liquor wastes. As shown in the drawing, the system is a "load it, forget it" combination of standard Omega units engineered for continuous, automatic operation. Soda ash is fed by an Omega Rotolock Feeder in response to a pH Controller — at rates varying over a 15 to 1500 lbs. per hr. range. The Rotolock Feeder's high volumetric accuracy (within ±1%) and wide range insure proper waste neutralization under all flow conditions.

This system—selected from the many available Omega chemical feeding "equipment packages" — was engineered in cooperation with Howard, Hickerson and Jordon, Engineers-Architects, of Nashville, Tenn. Omega welcomes the opportunity of working with you and your engineers in the application of Omega Feeders to your chemical feeding problems.

See Omega Continuous Chemical Feeders in operation at the National Chemical Exposition in Chicago — October 12-15.

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☐ Send Bulletin 45-H8 describing Omega Rotolock Feeders.

☐ Send "Industrial Waste Treatment Guide" (Bulletin BIF-4A)—also details on other Omega waste treatment "packages".

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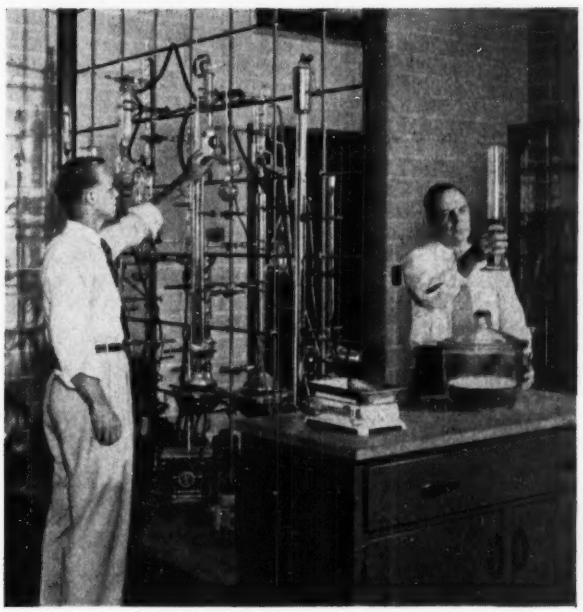
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New Process Patents *(continued)*

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No.
Inorganic chemicals, cont.	Solution phase process for conversion of sodium sulfide into sodium salts of carbonic acid	Rayonier, Inc.	2,675,297
	Hydrazine manufacture	Mathieson Chemical Corp.	2,675,298-300 & 2,675,302 & 2,675,911
	Production of hydrazine	The M. W. Kellogg Co.	2,675,301
	Recovery of iodine from oil well brine	The Texas Co.	2,676,092
	Concentration of phosphate ores	Attapulgus Minerals & Chemicals Corp.	2,676,705
	Production of uranium tetrachloride	U. S. Atomic Energy Commission	2,677,592
	Manufacture of hydrazine sulfonates	De Directie van de Staatsmijnen in Limburg	2,677,599
	Hydrazine sulfate preparation	Mathieson Chemical Corp.	2,682,446
	Manufacture of hydrazine	The M. W. Kellogg Co.	2,683,078
Metals and ores	Titanium oxides production	Horizons Titanium Corp.	2,681,847-51
	Zinc smelting	The National Smelting Co. Ltd.	2,682,462
Organic chemicals	Purification of benzene hexachloride	Imperial Chemical Industries Ltd.	2,674,569
	Production of tetrachlorocyclohexanones	Henkel & Cie.	2,674,572
	Preparation of vinylidene chloride using ultraviolet light	Soc. Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain	2,674,573
	Acetal production	Soc. des Usines Chimiques Rhone-Poulenc	2,674,625-6
	Preparation of alkyl-nitro-aromatic ketones	Monsanto Chemical Co.	2,674,628
	Production of hydroperoxides of hydrocarbons	Soc. des Usines Chimiques Rhone-Poulenc	2,674,629
	Cracking fluorine cpds.	Allied Chemical & Dye Corp.	2,674,630-1
	Chlorination of hydrocarbons	Otto Reitlinger	2,674,633
	Hydrogenation of polyunsaturated cpds.	Shell Development Co.	2,674,634
	Aromatics from petroleum by thermal conversion	Sinclair Refining Co.	2,674,635
	Alkylating isobutane with ethylene	Standard Oil Development Co.	2,674,637
	Paraformaldehyde production	Celanese Corp. of America	2,675,346
	Air oxidation of cycloalkanes	Standard Oil Development Co.	2,675,407
	Dehydration of formaldehyde	E. I. du Pont de Nemours & Co.	2,676,143
	Manufacture of beta-methyl-mercaptopropionaldehyde	E. I. du Pont de Nemours & Co.	2,676,190
	Alkyl phenols from gasoline	Universal Oil Products Co.	2,676,192
	Separation of straight chain primary alcohols from mixtures	Standard Oil Development Co.	2,676,995
	Dechlorination of chloroethane	The Dow Chemical Co.	2,676,997
	Chlorinolysis of methane	Diamond Alkali Co.	2,676,998
	Separation of organic cpds. by urea complex formation	Socony-Vacuum Oil Co., Inc.	2,681,332-7
	Separation of phenols from thiophenols	The Texas Co.	2,681,369
	Manufacture of ethyl and vinyl chlorides	Ethyl Corp.	2,681,372
	Production of chloromethyl methyl ether	The Dow Chemical Co.	2,681,939
	Preparation of monochloropropionic acid	Minnesota Mining & Mfg. Co.	2,682,504
	Hydrocarbons oxidation	Continental Oil Co.	2,682,553
	Vinyl formate preparation	Eastman Kodak Co.	2,682,556
	Pentaerythritol crystallization	Heyden Chemical Corp.	2,682,564
	Polymerizing olefins	Standard Oil Development Co.	2,682,565
	Gas recovery in the sulfochlorination of hydrocarbons	Standard Oil Development Co.	2,683,076
	Single-stage preparation of alcohols from CO, H_2 and olefins	Standard Oil Co. (Ind.)	2,683,177
Resins	Production of clear, pigmented oil-in-water resin emulsions	Laszlo Auer	2,681,322
	Acetone-formaldehyde resin manufacture	Harvel Research Corp.	2,683,133
	Production of ethylene polyamine-modified urea-formaldehyde resins	Allied Chemical & Dye Corp.	2,683,134
	Production of water-dispersible sulfonates of alkenyl aromatic resins	The Dow Chemical Co.	2,683,137
Rubber	Coagulating polymer latices prepared in true aqueous emulsion	Shell Development Co.	2,673,193
	Latex foam production	U. S. Rubber Co.	2,673,723
	Preparation of lignin-reinforced rubber	West Virginia Pulp & Paper Co.	2,676,931
	Rubber processing in the presence of carbon black and an organic peroxide	U. S. Rubber Co.	2,676,944
	Preparation of high solids synthetic rubber latex	Standard Oil Development Co.	2,676,951
Synthesis gas and products	Removing cobalt and iron from oxo aldehydes	Standard Oil Development Co.	2,681,368
	Upping the yield of water-soluble chemicals in hydrocarbon synthesis	Stanolind Oil & Gas Co.	2,681,924
	Hydrocarbon synthesis process	Standard Oil Development Co.	2,682,552 & 2,683,158
	Synthesis gas preparation	The M. W. Kellogg Co.	2,683,121 & 2,683,152
	Catalytic synthesis of hydrocarbons	The Texas Co.	2,683,159
Synthetic fibers	Dextran filament manufacture	The Commonwealth Engineering Co. of Ohio	2,674,517
	Fiber spinning composition	The Chemstrand Corp.	2,676,952
	How to make wetspun acrylonitrile filaments nonporous	E. I. du Pont de Nemours & Co.	2,677,590-1
	Aging alkali cellulose	Rayonier Inc.	2,682,536
	Removing CS_2 with oil from viscose yarn	E. I. du Pont de Nemours & Co.	2,683,072
	Process to prevent nylon gel formation	E. I. du Pont de Nemours & Co.	2,683,073
Vitamins	Fractional liquid extraction of vitamins	Hoffmann-La Roche Inc.	2,676,903
	Making vitamin A and intermediates	Eastman Kodak Co.	2,676,990-2 & 2,676,994
Water	Water softening	The Permutit Co.	2,676,922
Waxes	Wax separation by adduct formation	Socony-Vacuum Oil Co., Inc.	2,681,303
	Wax oxidate production	The Texas Co.	2,681,357
	Continuous wax production from ethylene and a normally liquid organic	Allied Chemical & Dye Corp.	2,683,141

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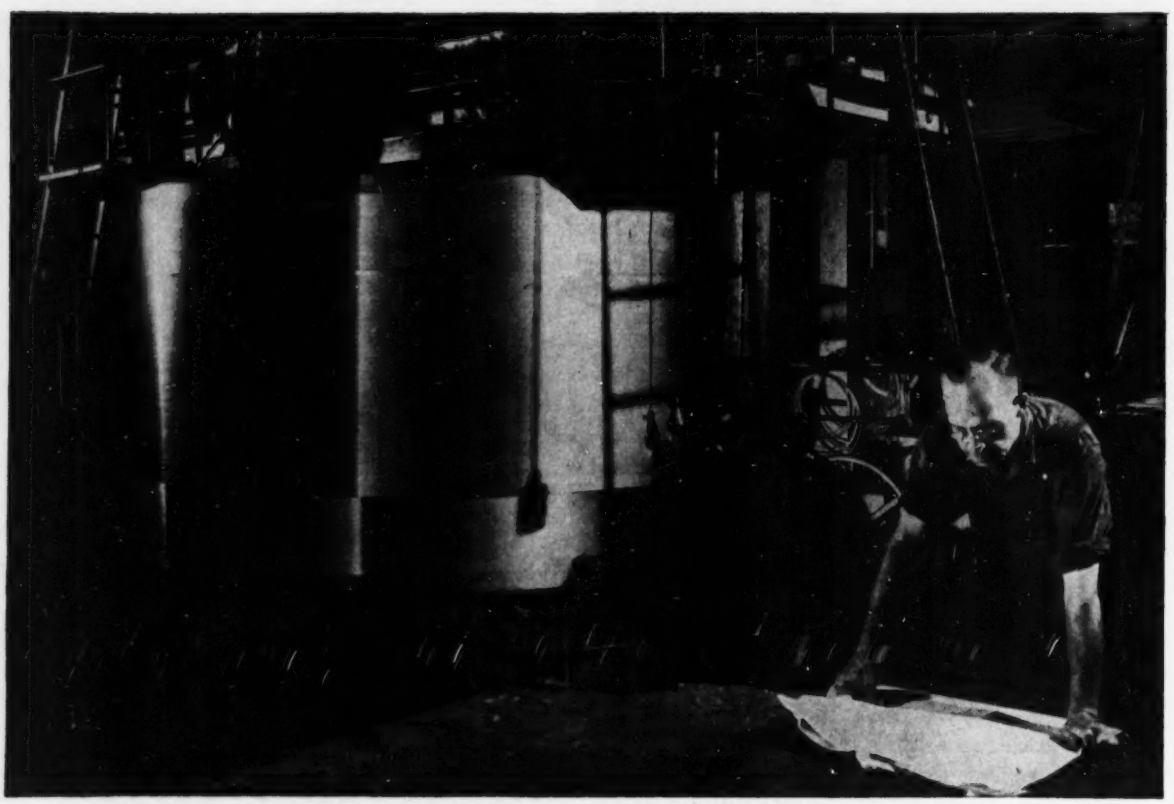
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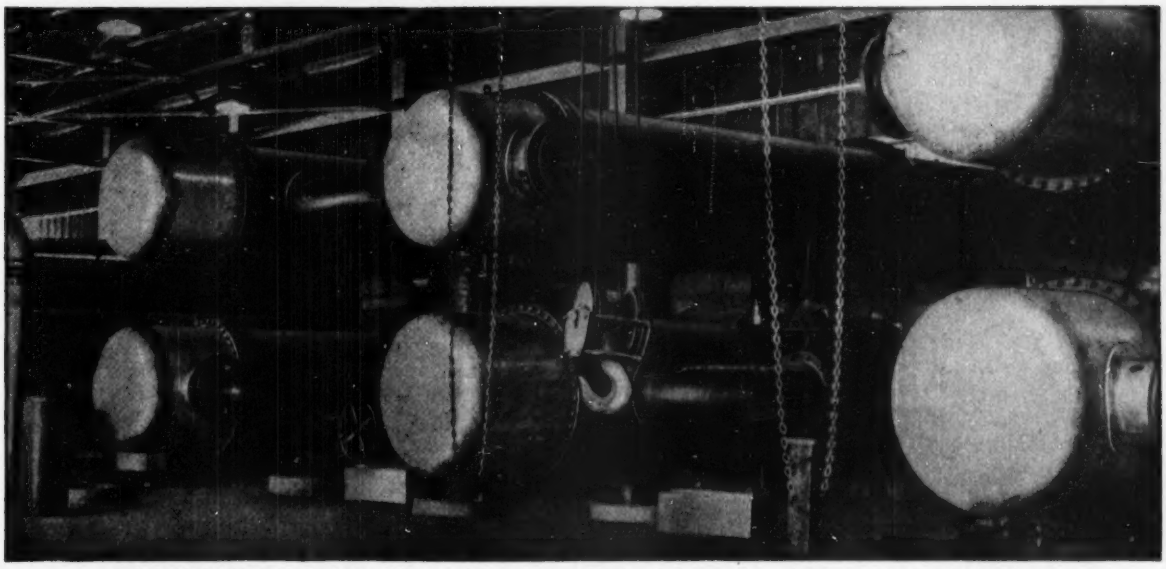
Profit-building answers to Modern

...examples of the wide variety of heavy-metal equipment designed and built by Alco to meet today's demands in petroleum and petrochemical processing . . . results of **Alco Experience** . . . gained through many years of designing and building heavy-metal equipment for refining and processing companies the world over . . . and **Alco Facilities** . . . capable of handling economically an extremely wide range of metal-fabricating operations . . . of meeting strictest customer specifications.

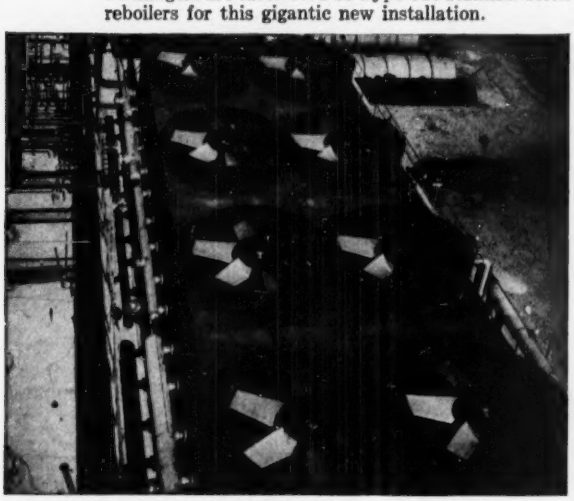


LARGE-DIAMETER BORING MILL, equipped with two rail heads and capable of handling work 25 ft 0 in. high, is typical of the complete, modern production facilities in Alco's shops which can produce virtually every type of heavy-metal equipment for the petroleum, chemical and power industries.

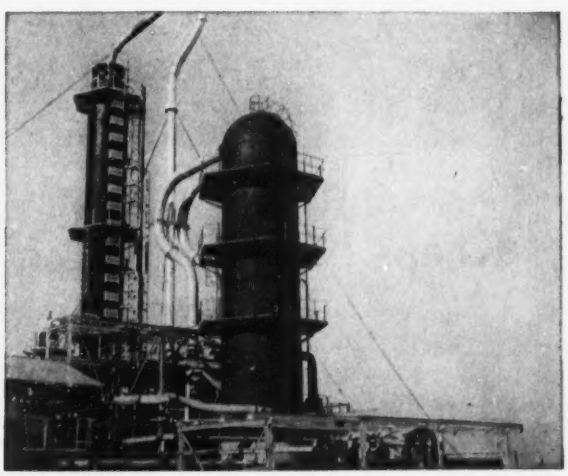
Processing problems



HEAT EXCHANGERS, built by Montreal Locomotive Works, Ltd., an Alco affiliate, ready for final piping in the Edmonton plant of The Canadian Chemical Company, Limited. Heads, tubes and tube sheets of these exchangers are fabricated of Type 316 stainless steel. MLW has supplied more than 200 heat exchangers and reboilers for this gigantic new installation.



AIR-COOLED HEAT EXCHANGERS were supplied by Alco for Celanese Corp., of America's new Pampa, Texas, plant. Mounted in 17- by 24-ft induced-draft housings, each cooling bank is equipped with two Monel fans supported on silicon rubber. Total heat dissipation from this specially engineered installation is 229,400,000 Btu per hr, a record for air-cooled condensers.

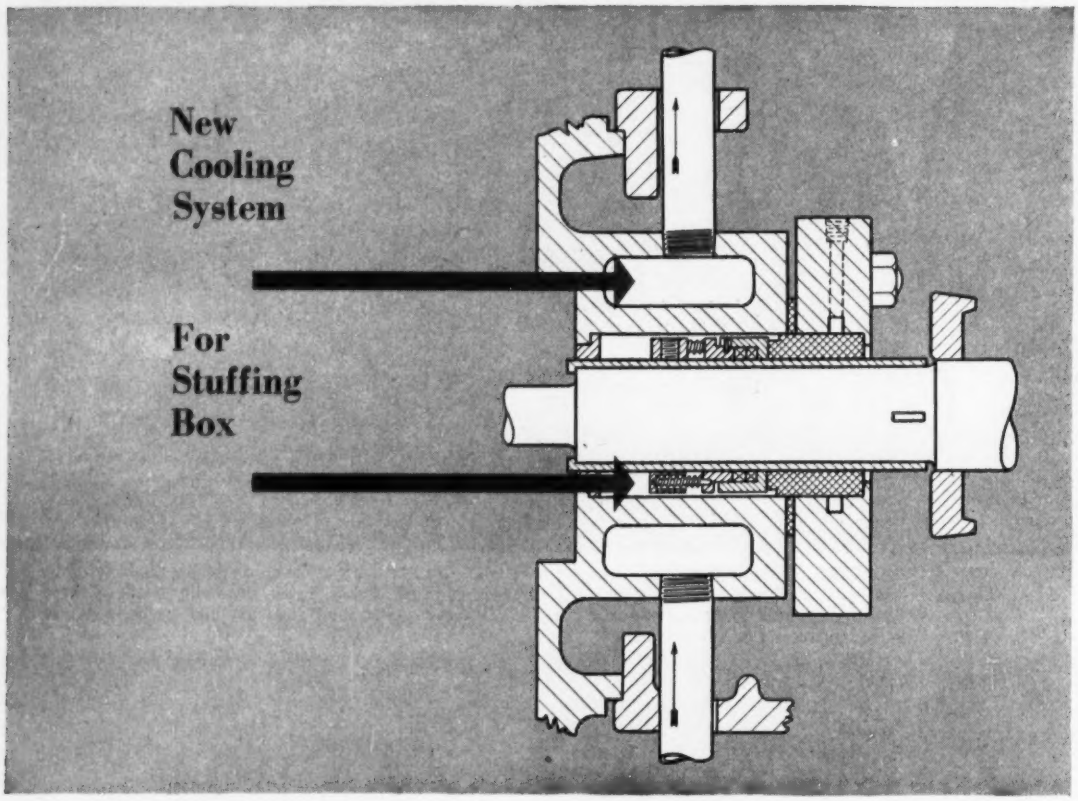


WORLD-WIDE USE of Alco equipment is typified by the wide range of Alco coolers, exchangers, condensers and heaters in service at the Aquila refinery in Trieste, Italy. Operating on Middle Eastern crudes, Aquila's annual capacity is over 900,000 tons with products including high-octane gasoline, top-quality lubricating oils and several types of asphalts and paraffin waxes.

You can find your own profit-building answers by using Alco facilities and experience on your processing problems. Contact your nearest Alco Products sales representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

ALCO
PRODUCTS
AMERICAN LOCOMOTIVE COMPANY
Sales and Service Offices in Principal Cities

NEW FLUIDS HANDLING EQUIPMENT



Keeps Seal Tight at High Temperature

Using standard, single, mechanical seals a redesigned line of process pumps now handles liquids up to 750 F for long periods without shutdown. By contrast, seals of this type generally are limited to a maximum operating temperature of 400 F.

The secret, of course, is that the seal actually is kept cool even though the pump is working on high temperature liquid. And credit for keeping the seal cool goes to an effective cooling jacket around the stuffing box; one that reduces stuffing box temperature without undue cooling of the process liquid in the body of the pump.

How well the cooling system works is shown on the accompanying curve for tests on a 2x3 pump run from shutoff to maximum capacity. With a constant coolant rate of 5 gpm., variations in capacity and head conditions did not make any measurable change in the stuffing box temperature.

Actual operation in the field has revealed 3 to 4 months unattended continuous performance. Examination of seals at the end of this period showed slight wear on seal faces but not enough to require new carbon inserts. The pumps have continued to give satisfactory service to date.

The seal being used on these pumps is a standard type that is readily available and interchangeable with conventional packing.

Cooling jacket position has been localized about the stuffing box. It extends along the full length of the box to cool liquid within the box without cooling the liquid within the pump.

Circulation of high temperature liquid from the casing to the stuffing box has been held to a minimum. Liquid within the box is cooled well below the temperature limit of the seal at all times.

Stuffing box depth is sufficient so that cooling of the shaft is adequate to prevent damage to the mechanical seal and Teflon packing.

Cooling water for the pump can

Only the Wiggins Gasholder*


NO WATER


NO TAR


NO GREASE

has the dry fabric seal that



NO WEATHER WORRIES


NO CLOSE TOLERANCES TO JAM PISTON

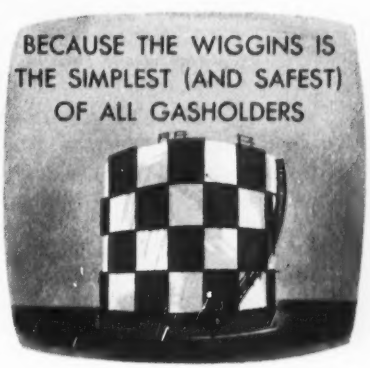

NO CONSTANT INSPECTION. —ALL AREAS ACCESSIBLE

eliminates maintenance problems!


NO MECHANISM TO RUST OR BREAK


NO OPERATING COST

BECAUSE THE WIGGINS IS THE SIMPLEST (AND SAFEST) OF ALL GASHOLDERS



Write for information

WIGGINS VAPOR SEALS
GENERAL AMERICAN
TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street
Chicago 90, Illinois

*PATENTED

Equipment on these pages made news this month . . .

Page number is also Reader Service code number

New Fluids Handling Equipment

- High Temperature Pump 264A
- Gas Scrubber 266A
- Acid Tank Covers 266B
- Tablet Press 266C
- Extreme Pressure Compressor 268A
- Pump 270A
- Teflon Bellows 270B
- Plastic Pipe 270C

New Packaging & Handling Equipment

- Paper Pallet 272A
- Drum Filler 272B
- Batch Weigher 272C
- Small Power Shovel 272D

New Electrical & Mechanical Equipment

- Mobile X-Ray 274A
- Power Outlet 274B
- Shaft Coupling 274C
- Reduction Gear 274D
- Breaker Enclosure 274F

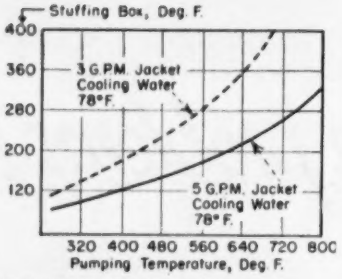
New Processing Equipment

- Resin Extruder 276A
- Filter Cover 278A
- Disk Disperser 278B
- Pulverizer 278C

New Instruments & Controls

- Pressure Balance 280A
- Indicating Amplifier 280B
- Telemetering System 280C
- Mass Spectrometer 280D
- Gas Flow Meter 282A
- Heat Recorder 282B
- Vibration Control 282C
- Differential Converter Transmitter 282D
- Hygrometer 282E
- Temperature 282F
- Remote Indicator-Recorder 282G

. . . For more details, use Reader Service Card on page 497



DEGREE of cooling with redesign.

be taken directly from the plant supply. Since it is not contaminated in passing through the cooling jacket it can be returned to the plant supply. No special coolant or auxiliary equipment is needed.

Present field installations include units up to 6-in. size at temperatures up to 750 F. Pumps built with mechanical seals for high temperature service range in capacity from 10 to 5,000 gpm. and total dynamic heads up to and including 500 ft.—**Dean Brothers Pumps Inc., 323 West 10th St., Indianapolis 7, Ind.** 264A

Small Scrubber

Removes air-borne acid fumes by spray-injection of water.

Designed for spot use in the chemical processing industries the model A Scrubjet prevents discharge of acid fumes to the atmosphere. Units already installed are effectively scrubbing fumes of hydrochloric, phosphoric and hydrobromic acids.

Gas entering the unit contacts a spray injection of water traveling in the same direction. Water leaves through a trap at the bottom of the unit. Scrubbed gas reverses direction and discharges through a small tower packed with Raschig rings that removes any entrained mist.

Scrubjet A is suitable for 125 psi. gas-line pressure, comes in four sizes for 10 to 100 cfm. of gas or air. Water consumption varies from 0.86 to 3.7 gpm. It's built of either Saran-lined steel, phenolic-coated steel or Type 316 stainless steel.—**Saran Lined Pipe Co., 2415 Burdette Ave., Ferndale (Detroit 20, Mich.** 266A

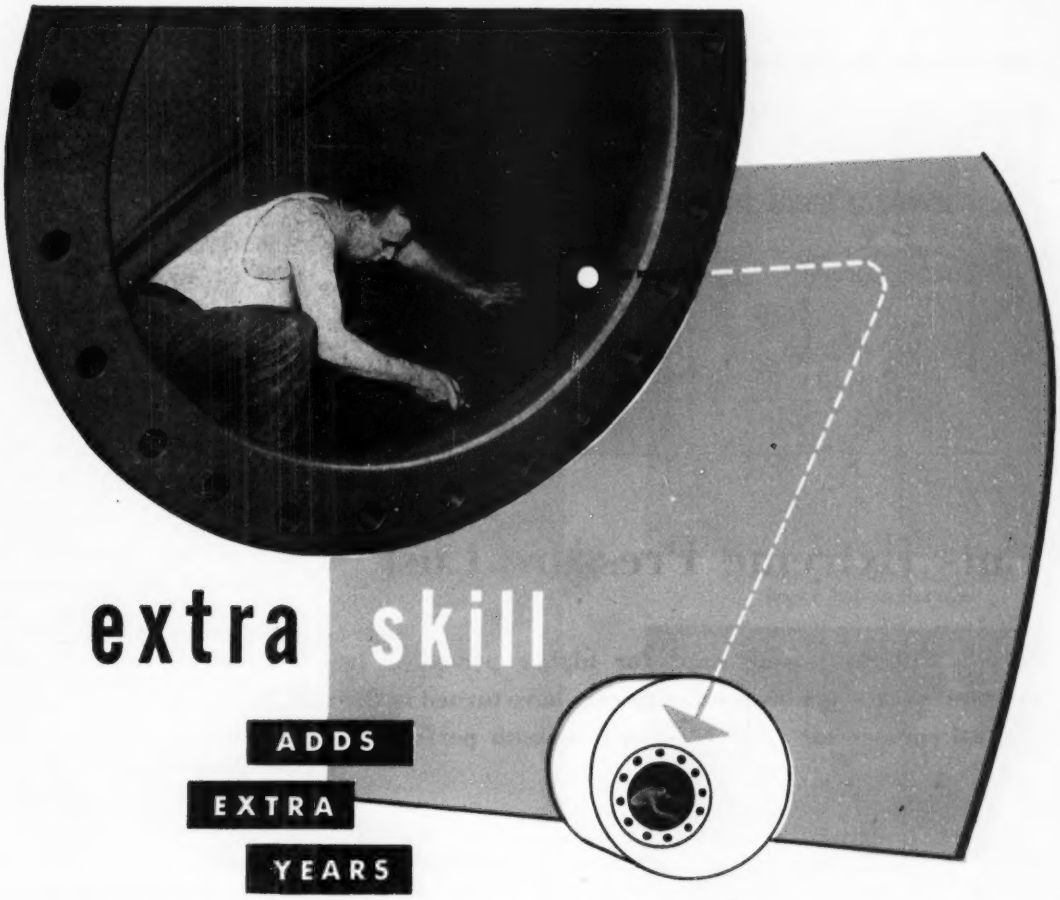
Tank covers for acid process tanks are fabricated of Rigidon plastic. In sizes up to 18 ft. dia, they are light weight and have good structural strength at elevated temperatures. Pigmented color is incorporated to cut maintenance costs. Special openings and outlets can be furnished.—**Heil Process Equipment Corp., 12901 Elmwood Ave., Cleveland 11, Ohio** 266B

Tablet press produces far more than any comparable machine, has low first cost and tool cost. Producing at a rate of 1150 tablets per min. this single rotary press handles tablets up to $\frac{5}{8}$ in. dia. with $\frac{3}{4}$ in. cell depth.—**Arthur Colton Co., 3400 East Lafayette, Detroit 7, Michigan** 266C

For More Information . . .



about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



extra skill

ADDS
EXTRA
YEARS

The men who put the Ace rubber lining in this steel tank know that acid seeping through a pinhole . . . or a tiny blister . . . may cause needless expense for repairs years from now. They know that the cost of *sure* protection *now* is less than the cost of patching up or scrapping equipment that fails too soon. For that reason they work to the highest standards of perfection and skill.

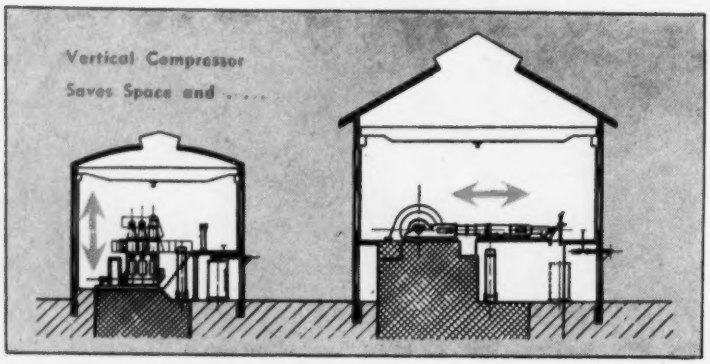
Before the lining is applied, every inch of steel is grit blasted. Weld fillets are ground smooth. The rubber itself — a compound selected specifically for the chemicals *this* tank is to hold — is laboratory-controlled at every step. The lining is two layers deep — soft rubber for firm, resilient bond, with age-proof, corrosion resistant *hard* rubber on top. Seams are wide, carefully rolled down. Fillets get extra protection. Final step is 35,000-volt brush test sensitive enough to spot any unsuspected weakness up to 8 inches away.



If you want this *sure* protection against corrosion, write Ace today for data on equipment available, and lists of corrosives that can be handled by Ace rubber or plastics.

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93 WORTH STREET • NEW YORK 13, N. Y.



Cuts Extreme Pressure Cost

With increasing need for higher pressures in chemical synthesis European engineers have turned to the vertical compressor as a cost-saving, smooth performer.

Building compressors for extreme pressures such as found in polyethylene synthesis has posed some serious design problems. In Europe, many of the mechanical problems have been resolved through adoption of a vertical design in preference to the more conventional horizontal type. And the switchover has proved so sound that this type unit now is preferred also for medium pressures.

▶ **Money in the Pocket**—Aside from mechanical advantages, manufacturers have found the vertical units offer some noteworthy savings on initial expenditure, operating and maintenance expenses.

On building and foundation costs the vertical compressors save up to 75%. Floorspace is only 30% of that needed for horizontal machines (intercoolers included for both). Over-all dimensions of the building can be lower and narrower.

▶ **Operating Center**—Operationwise, vertical units are controlled from a panel on the obstruction-free platform. All instruments, safety valves, bypasses, blowdowns etc. are located there.

From the operating platform there is a clear view of the entire installation. Compressor valves, stuffing boxes etc. are accessible from this level.

Below the operating platform are found the drive motor, driving mechanism, intercoolers, condensate traps and connecting piping.

Maintenancewise, vertical compressors can be serviced with minimum downtime. Crews can work simultaneously on different levels and sides of the machine.

▶ **Stays in Place**—Rigidity in a compressor keeps misalignment at a minimum despite pulsating elastic deformations caused by alternating compression and inertial forces.

Design of the vertical unit permits maximum rigidity. The driving mechanism consisting of crankshaft, connecting rods and crossheads can have a common housing like a ship's diesel engine. On top the cylinders for the different stages can be bolted together. Such practice cannot be followed with horizontal compressors because it would hamper accessibility to various parts.

▶ **Bearings**—Main bearings on vertical machines are split horizontally with the upper cap held down to the lower crankcase by studs and nuts. This is a good arrangement because the forces holding the bearing together are directly opposed to the acting forces of gravity, inertia and compression.

In the horizontal machine compromise bearing arrangements have been worked out by various manufacturers. Reason is that the acting forces are not all in the same direction. Gravity acts vertically but inertia and compression forces are horizontal.

Lubricant can be distributed evenly with ease on the vertical units. It is introduced at the top and runs down through the unit by gravity. In case of partial failure of lub-oil distribution, overheating will be even and with less danger of permanent damage than with horizontal units.

For medium and extreme pressure needs the vertical compressor appears to face a bright future.—**F. C. Versteegh, Rm. 217, 753 Bush St., San Francisco 2, Calif. 268A**

Vertical vs. Horizontal

	7-stage Vertical	7-stage Horizontal
Discharge pressure, psi	14,300	14,300
Capacity, cfm.	2,240	2,240
Stroke, in.	18	28
Speed, rpm.	212	122
Floorspace, sq. ft.	650	2,150
Building volume, cu. ft.	2,650	10,600
Foundation, cu. yd.	208	970
Cost of building, relative	1.0	4.0
Cost of foundation, relative	1.0	4.66

Note: This comparison is for one location but should be generally true. It does not take into consideration that costs for overhead crane and main synchronous drive motor are lower for the vertical unit.

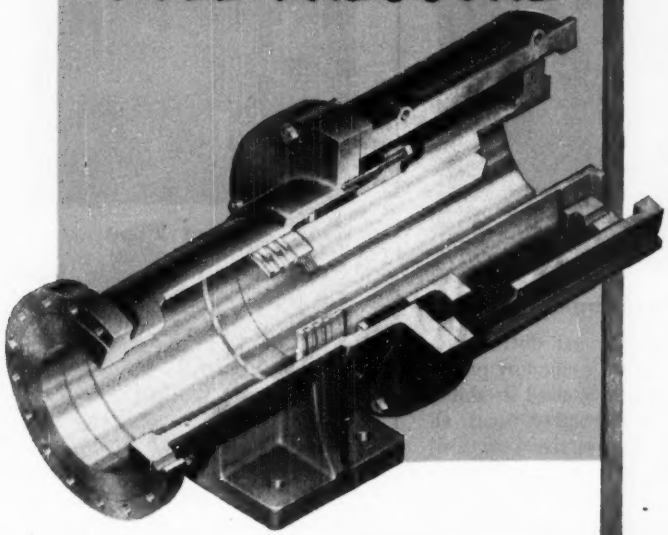
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ADSCO EXPANSION JOINTS...

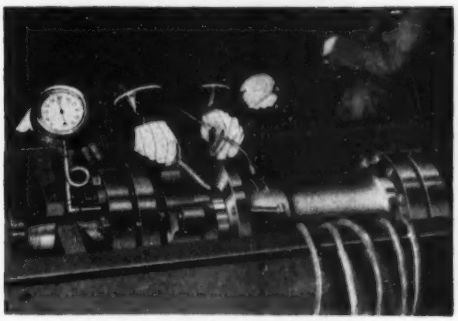
UNPACKED AT FULL PRESSURE



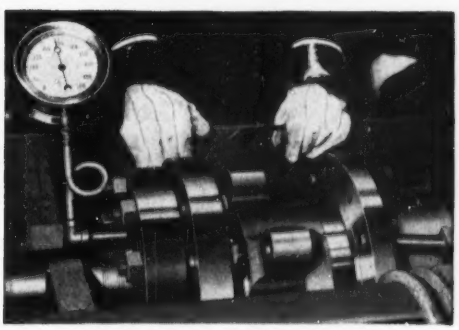
▶ ADSCO piston-ring expansion joints can be serviced . . . in fact, unpacked and repacked . . . under full line pressure. There is no interruption of service, no down-time for repacking, because the job is done under normal working conditions.

▶ Yet this isn't the only great feature of this high-quality joint. Slip is completely guided . . . split external guide permits smaller manholes . . . limit stops prevent over-travel of slip . . . polished surface cannot be scored because slip is in contact with packing only . . . misalignment is prevented by both internal and external guiding. ADSCO piston-ring expansion joints are available in a full range of sizes, with 4", 8", or 12" traverse per slip, for pressures to 400 psi and greater and for temperatures to 800F and higher. Call an ADSCO representative or write for Bulletin 35-15H.

. . . and here's proof



Last strand of packing being withdrawn from stuffing box.



Close-up photograph shows all packing removed. With steam at 240 lbs. pressure and with 300° superheat there is no trace of steam in the empty stuffing box.

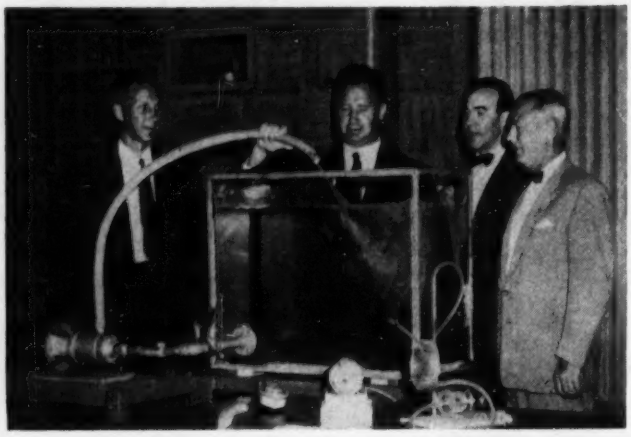
With periodic adjustments of the gland, it may never be necessary to repack the stuffing box in an ADSCO piston-ring expansion joint. However, lack of maintenance may make it necessary at some time to do so and the job is easy with this ADSCO joint. The piston rings hold the line pressure during the unpacking and repacking operation. With the vent valve open, the vent chamber is at atmospheric pressure and, under this condition, no steam can enter the stuffing box space. Thus complete repacking can be done under full line pressure.

ADSCO ENGINEERED PRODUCTS

EXPANSION JOINTS
HEAT EXCHANGERS
STEAM TRAPS
STRAINERS
SEPARATORS
METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS: NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.



Wooed by Television, Won by Performance

In its first performance on Bennett Productions' Big Idea TV program the Vibro-Pump (*Chem. Eng.*, May '52, p. 220) was seeking a manufacturer. Recently, Inventor Gemeinhardt returned to the program with officials of the H&H Mfg. Co. which now is producing the pump for general distribution. Operating on a vibratory principle the pump showed its ability to handle slurries of beans, elbow macaroni, sand and rivets. It also can pump mud and liquids with up to 20% vapor.–H & H Mfg. Co., Sycamore & Mill Rd., Clifton Hgts., Pa. 270A



High Impact Pipe

Withstands chemicals, high working pressures and heavy impact.

If this is a peek at the future and a typical pipefitter for lightweight rigid plastic pipe then we'll all be stampeding to buy in carload lots. Maybe it's a harbinger of things to come when a young lady can shoulder with ease three 10-ft. lengths of pipe.

This new, rigid, high-impact Koroseal pipe is tough, durable and able to withstand rough handling and hard usage under severe operating conditions. It is chemically resistant, odorless, will not rot, rust or corrode and has excellent aging properties for indoor, outdoor and underground use.

Furnished in lengths to 20 ft. and diameters from ½ through 2 in. the new pipe costs less than equivalent sizes of stainless steel pipe. Threaded fittings are standard; flanged connections are recommended for joining Koroseal pipe to other pipe systems.–**B. F. Goodrich Co., Industrial Products Div., Akron, Ohio. 270C**

Teflon Bellows

Available with companion flanges conforming to standard circles and numbers.

Bellows of Teflon now are furnished with companion flanges that conform to American Standard bolt hole circles and numbers for pressures up to 125 psi. Satisfying need for chemical inertness, and resistance to corrosion and heat they are used as vibration dampeners, expansion joints and connectors. A wide range of designs finds use for metering pumps, pressure accumulators, batching scales, hydraulic systems and others.

A new convolution form gives greater strength, longer life and increased flexibility. Retaining formation at full free length, the bellows are subjected to minimum residual and working strain. Operating temperature range is from −94 to +500 F.–**Crane Packing Co., Dept. CE, 1800 Cuyler Ave., Chicago 13, Ill. 270B**

EQUIPMENT COSTS

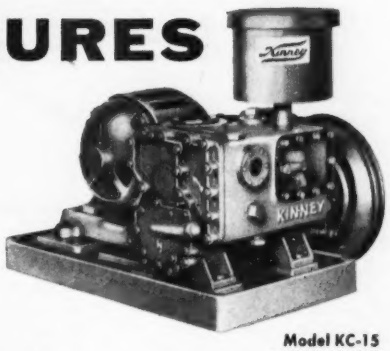


Process Industries	Mar. 1954	June 1954
Cement mfg.	177.8	178.0
Chemical	186.4	186.6
Clay products	172.6	172.8
Glass mfg.	176.2	176.4
Paint mfg.	179.5	179.7
Paper mfg.	179.8	180.0
Petroleum ind.	183.0	183.2
Rubber ind.	185.4	185.6
Process ind. avg.	183.5	183.7

Related Industries		
Elec. power equip.	188.3	188.5
Mining, milling	187.4	187.6
Refrigerating	205.1	205.3
Steam power	175.7	175.9

Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1954, pp 214-5 for annual averages since 1913.

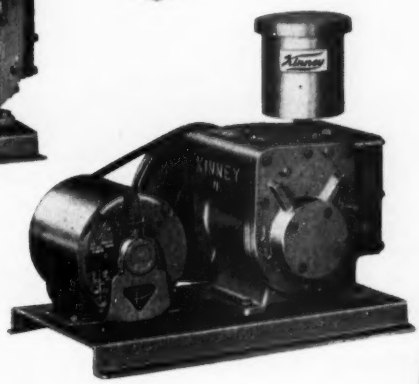
FOR LOW LOW PRESSURES



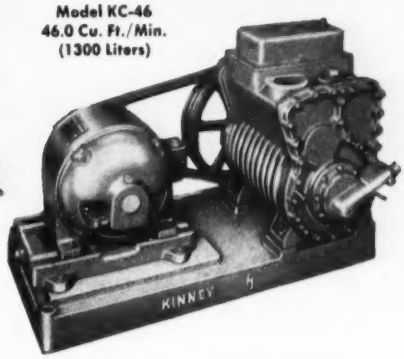
Model KC-15
15.2 Cu. Ft./Min.
(430 Liters)



Model KC-2
2.0 Cu. Ft./Min.
(57 Liters)



Model KC-5
4.9 Cu. Ft./Min.
(140 Liters)



Model KC-46
46.0 Cu. Ft./Min.
(1300 Liters)

Kinney Compound Vacuum Pumps produce low absolute pressures of 0.2 micron (McLeod) or better completely unassisted. They are quick starting, high pumping speed units, designed to answer every requirement of the laboratory or pilot plant. All four of these pumps can be effectively ***gas-ballasted*** for handling water-vapors.

Write us about your vacuum problems. Competent vacuum engineers in all our district offices are ready to help you. Send coupon for details. Kinney Mfg. Division, Boston 30, Massachusetts.

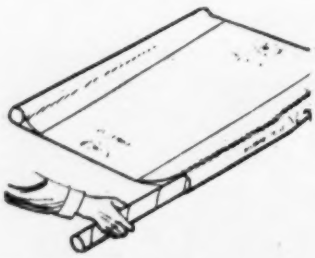
Kinney

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.

☐ Please send Bulletin V54 describing the complete line of Kinney Vacuum Pumps.

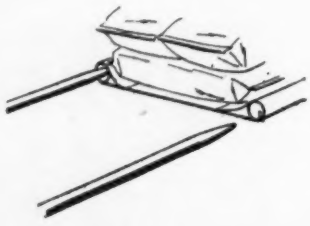
☐ Our vacuum problem involves.....

Name.....
Company.....
Address.....
City..... State.....



Paper Sling and . . .

Just insert a paper tube in each end of this paper sling and you have an Accopak pallet. Loaded pallet (up to 24 80-lb. bags) is picked up by bayonet forks designed to fit any



Bayonet Truck Forks . . .

fork-lift truck. Unit load can be stacked in single, double or triple tiers without removal of pallet during storage or shipment. Accopak pallets cost less than expendable,



Speed Handling, Cut Cost

paperboard pallets; save 8 to 10 hr. unloading time compared to non-unitized methods.—American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y. 272A



Drum Filler

Delivers accurate amount of liquid to 30 or 55 gal. drums.

Up to 60 drums per hr. can be filled accurately by the Diafram filler. Completely free of intricate meters it uses a unique, double diaphragm for accuracy within 0.001% in 30 or 55 gal.

Machine has an all-steel, eliptical filler body divided by the double diaphragm. Each side of the body is connected to a common 4-way valve.

Entering liquid is directed by the valve first to one side of the diaphragm then the other. Liquid entering on one side of the diaphragm forces liquid within the body on the other side of the diaphragm to discharge through the other part of the 4-way valve into the drum.

Discharge from either side of the filler is identical. The control valve can be operated either manually or by air.—**Drum Equipment Corp., 947 Lehigh Ave., Union, N. J.** 272B

Batch Weigher

For program batching of liquids and bulk materials.

Built around an SR-4 strain gage load cell the line of model 140 Auto-Batch weighing equipment has a simple design and low maintenance.

The system uses a tank or bin supported from the load cell which is connected to an electronic indicator, recording controller to convert the load signal into the proper functions, and a control relay box to sequence the functions in their proper order and duration.

Systems are built to handle batches from a few pounds to thousands of pounds. From one to 12 different ingredients can be included in a batch. Batching can be done in either single or repeat cycles.

Other features: remote location of instrumentation and control relay system, if desired; design for multi-tank or hopper installations where required; automatic tare check system; permanent record of each batch.—**Gilmore Industries, Inc., 5713 Euclid Ave., Cleveland 3, Ohio.** 272C

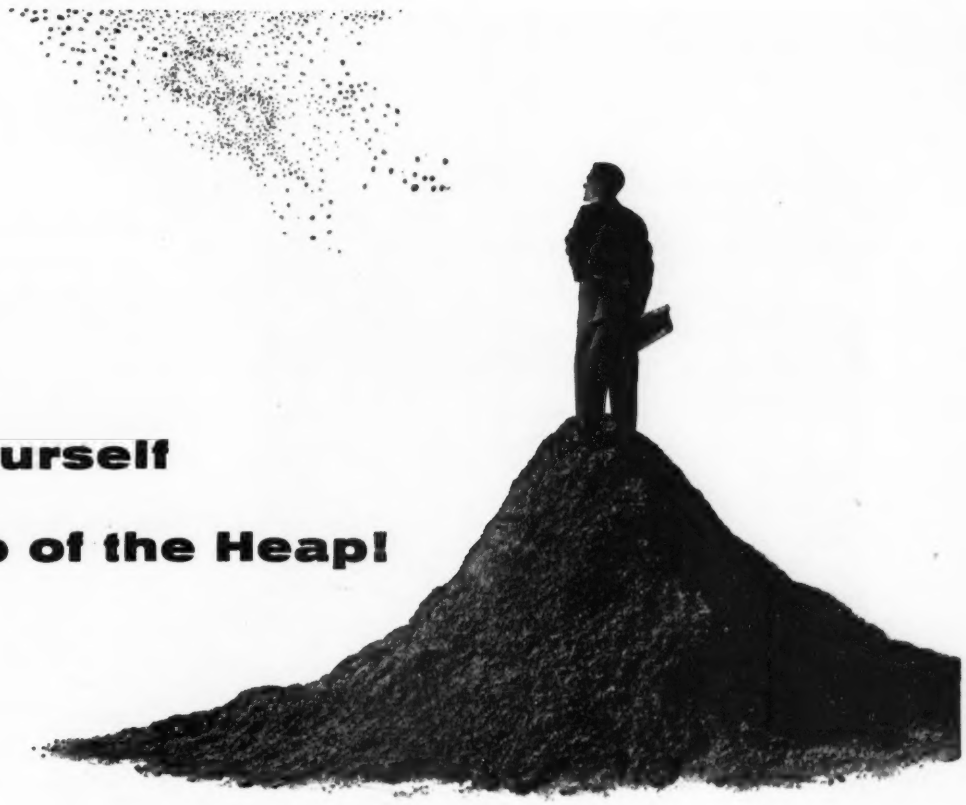


Small Power Shovel

Handles bulk materials in cramped quarters.

Bulk materials can be handled in confined space such as boxcars with the Bulkmaster mobile power shovel. Having a capacity of 11 cu. ft. the shovel is suitable for loosely packed materials such as fertilizer, chemicals, grain and sand.

Full shovel lifting speed is 6 sec.; dumping speed 1 sec.; lowering speed 3 sec. Turning radius is 73 in. for a body length of 109 in. and width of 46½ in.—**Clark Equipment Co., Battle Creek, Mich.** 272D



Put Yourself on Top of the Heap!

You can collect big money simply by collecting the valuable dust that's usually wasted in your plant's operations!

How much? Buell equipment frequently collects as much as 40 tons a day. Convert that into cash and you can see what you're missing!

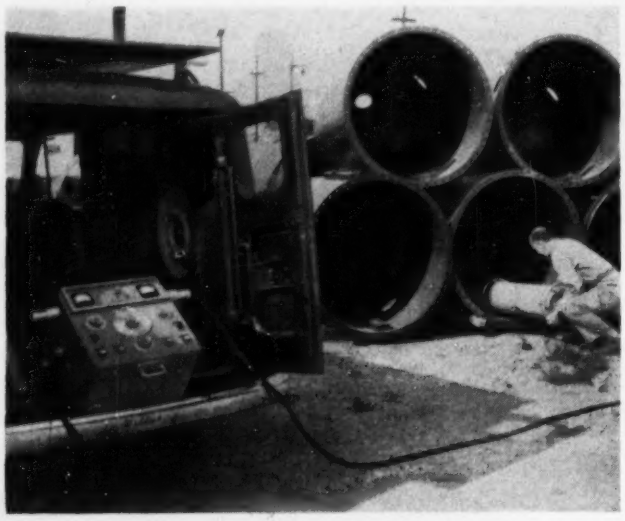
Buell specialists have developed three different types of dust collection equipment. The right equipment to handle *any* dust collection problem. Each is carefully tailored to meet your individual problem. Actually, each problem is different—each solution must be different to meet the many variables.

Buell equipment has set truly amazing records for efficiency . . . for low maintenance . . . for versatility. Why settle for less than the best? Write Buell Engineering Company, Dept. 12-J, 70 Pine Street, New York 5, N. Y.

buell

MECHANICAL ELECTRICAL

20 Years of Engineered Efficiency in
DUST RECOVERY SYSTEMS



Mobile X-Ray Ferrets Out Flaws

Probing X-Ray fingers now search out weld flaws in the field through this new mobile unit. Capable of X-raying steel up to 3½ in. thick the Resotron 250 (250,000 v.) is less than ½ the size and ⅛ the weight of a conventional ¼ million-volt unit. The 150-lb. head is shown being placed inside a vessel for weld inspection prior to erection. A snout protruding from the head can be inserted into smaller castings to check for imperfections. Unit can be used on anything from magnesium to steel.—General Electric Co., X-Ray Dept., Milwaukee 14, Wis. 274A

Power Outlet

Has mechanically interlocked safety switch and oil immersed parts.

Accidental shutoff of circuit power is avoided on the Rowan type 620-A3GX outlet by mechanically interlocking switch handle and plug. The plug cannot be inserted or removed while the switch is on. Power source must be opened by throwing the safety switch before the plug can be removed.

Oil immersion of the parts prevents freezing of the parts due to corrosion. Other features: sealed-off terminal compartments and safety jack; provision for padlocking the switch in the off position; top and bottom conduit entrance; and manually-operated disconnect switch of the contacter type with quick make and break mechanism. **—Crouse-Hinds Co., Wolf & 7th North St., Syracuse, N. Y. 274B**

Shaft Coupling

Offers maximum life, torsional strength, angular displacement.

Accurately-made couplings of the pinned, splined, keyed or flexible type are costly and short-lived when set to maximum misalignment. A new universal coupling is said to overcome these deficiencies by an equilateral tri-lobe shape on its driving members.

It is lighter and less costly than an equivalent universal spline coupling. In relation to its weight it provides greater axial and torsional strength with smooth and quiet operation under heavy loads.

Male members have a bow-like peripheral profile that permits 8° angular rotational displacement. Driving members are self-centering under all loads; have a 15% higher load carrying capacity.

Tri-lobe couplings are available in standard sizes up to 5-in. dia. **—Kerns Mfg. Corp., 45-18 Court Sq., Dept. 170, Long Island City 1, N. Y. 274C**

Reduction Gear

Is highly efficient at high reduction ratios.

Efficiencies on the order of 95 to 98% are claimed for the Cyclo reduction gear. Savings in power and reduced maintenance result directly from this characteristic.

Typical slow speed applications where this gear performs well are mixing vats, conveyors, ball mills and rotary furnaces.

Available either as a self-contained unit or as an integral motorgear it uses rolling elements to achieve its high efficiency yet has positive reduction without change or slippage. Horsepower range is from less than one up to 35 with speeds down to 0.2 rpm.**—The Ore & Chemical Corp., 80 Broad St., New York 4, N. Y. 274D**

Breaker Enclosure

Assures dependable operation in dust-laden atmosphere.

Patterned after Joint Industrial Conference requirements, a new circuit-breaker enclosure protects against lint, dirt, sawdust and other foreign matter; assures dependable operation.

Mounting holes and knockouts are omitted. External feet simplify mounting. Operating mechanism is located outside the enclosure. Neoprene gasket seals cover shut.

Enclosures are available for I-T-E circuit frame sizes *E*, *F*, *J* and *L*. Ratings are: 15-600 amp.; 125-600v. a.c.; 125-250 v. d.c.**—I-T-E Circuit Breaker Co., 19th and Hamilton St., Philadelphia 30, Pa. 274E**

For More Information . . .

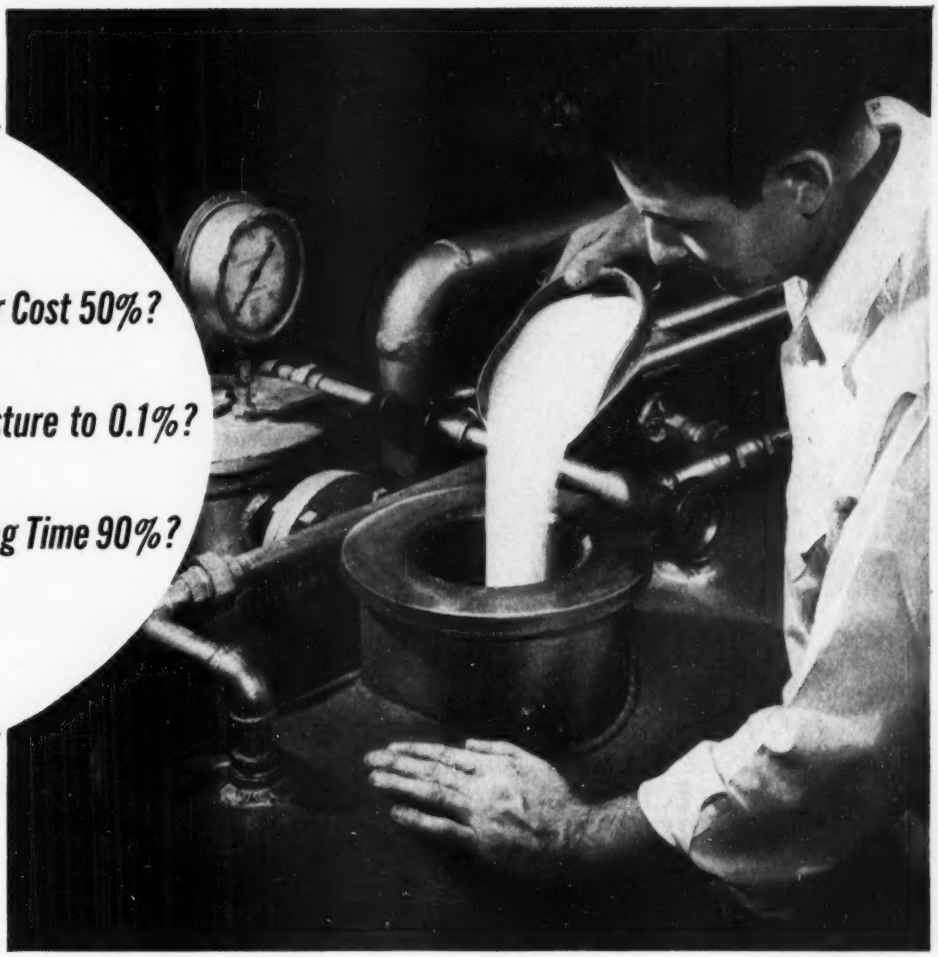


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What Cuts Labor Cost 50%?

What Cuts Moisture to 0.1%?

What Cuts Drying Time 90%?



Operator loads Rotary Vacuum Dryer in Stokes pilot plant.

Labor and time are reduced 50% by vacuum drying of a mixture of acetyl salicylic acid and other chemicals.

Sodium trichloracetate is reduced from 35% to 0.1% moisture content in 8 to 12 hours by vacuum drying.

Several makers of powdered aluminum and brass avert fire and explosion hazards by drying powders and solvents in vacuum . . . then recover 99% or more of the solvent in the same process.

Shellac is dried in vacuum in 6 to 8 hours per batch, a job that formerly took 72 hours!

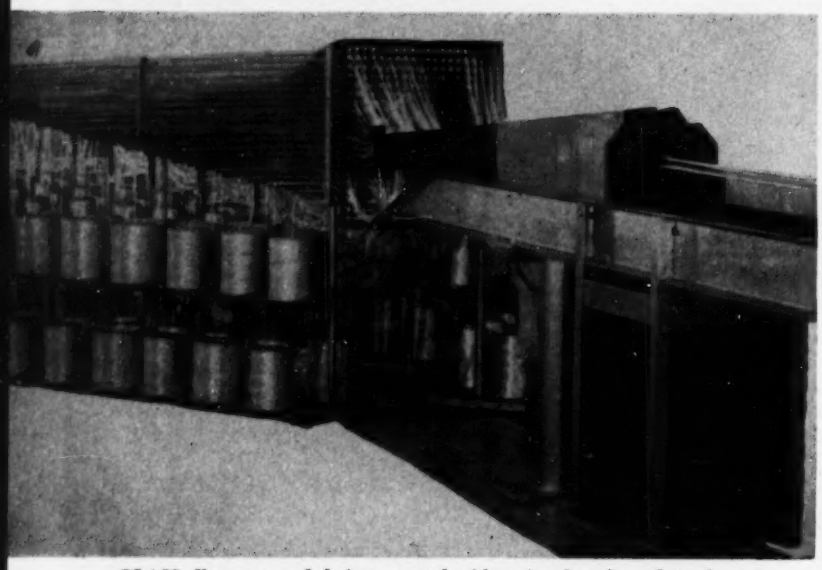
Stokes has the laboratory and pilot plant facilities to test vacuum drying of any product which offers drying difficulties. Methods, cycles, equipment, costs will be accurately determined. Stokes has 40 years' experience in vacuum technology to share with you on drying problems.

Send for an informative brochure, "Vacuum Drying," on the techniques of moisture removal from chemicals, pharmaceuticals and other industrial products.

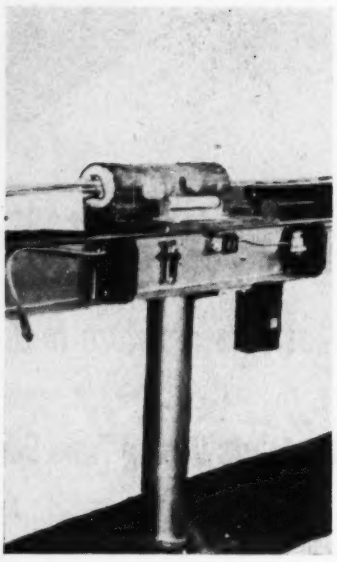
F. J. Stokes Machine Company
Philadelphia 20, Pa.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment



GLASS fibers are carded, impregnated with resin, then formed to shape in . . .



DIE and cured continuously by . . .

New Extruder for Thermosetting Resins

Now, reinforced plastics can be made in the same wide variety of shapes as extruded metals and thermoplastics. Being competitive, they'll widen plastic usage.

For the plastic fabricator it's good news; he'll be able to offer a new line of products and challenge extruders of competitive materials. No less interested will be the prospective user; he may find some new answers to some old problems.

▶**Powerful Challenge**—With the new Glastruder machine a wide range of cross-sectional shapes is being made, paralleling those produced by metal and thermoplastic extrusion techniques. Manufacturing tolerances are normal for this type of material; finish is commercially acceptable as the stock comes from the machine.

A wide range of fibers, resin types, catalysts, fillers etc. can be handled by the Glastruder to produce almost any specific property, as required. For the most part they will all be chemically inert suggesting use in many types of corrosive applications such as oil well screens, plating baskets and racks, low pressure piping, concrete reinforcing and all types of structural members subjected to corrosion.

▶**Cost Picture**—Prices for finished products generally will be under those for comparable monel, ceramic, rubber-coated or other similar material currently in use.

Machines are being built for operation in the U.S.A. on lease-fee plus monthly-rental basis. A number of advantages have been worked out for the operator that would not be available to him on an outright purchase.

▶**How Done**—In operation, the Glastruder is fed from spools the desired number of fibrous-glass rovings. Passing through a carder the rovings enter a dip tank where they are impregnated with liquid resin mixture, then threaded through a plastic die for forming to the desired size and shape. While passing through the forming bushing the glass-resin mass is cured rapidly to rigid shape by radio-frequency heating. The finished shape is withdrawn from the forming bushing by a pulling device and automatically cut to required length.

▶**Versatile**—One big advantage of the Glastruder is that equipment size and complexity do not increase

Typical Glastruder Product*

Tensile strength, psi.....	100,000 to 144,700
Modulus of elasticity.....	5.3×10^6
Compressive strength, psi..	40,000
Flexural strength, psi.....	64,000
Rockwell M. hardness.....	112
Barcol hardness.....	65
Specific gravity.....	1.85
Water absorption (weight change after 24 hr.), %..	+0.108
IZOD impact strength, ft. lb./ in. notch.....	17.1

* The specimen used in determining these specifications contained 65% Fiberglas, supplied by Owens-Corning Fiberglas Corp., and 35% polyester resin, supplied by General Electric Co. Because of the wide range of fibers, resin types, glass content, catalysts, fillers, pigments, and dyes used to make various Glastrusions for specific uses, these specifications are of a general nature and are not to be used as criteria.



The thousands of popular magazines on America's newsstands are made economically possible in large part by "Virginia" Zinc Hydro.

"VIRGINIA" ZINC HYDRO REDUCES PAPER MAKING COSTS

Maybe it can save money for you, too

Paper makers wanted a magazine sheet that could be sold for less than pure sulphite. "Virginia" Zinc Hydrosulphite (ZnS_2O_4) was used to brighten low-cost ground-wood to a point high enough so that this brightened furnish when mixed with bleached sulphite produced a sheet of desired color and strength.

Of course, your business may not be paper making. But "Virginia" reducing and bleaching agents, SO_2, Zinc Hydrosulphite and Sodium Hydrosulphite, are stellar performers in 40 diverse industries. We're always glad to discuss your particular problem.

"Virginia" technical men have the know-how and experience to help you get the quickest answers. Perhaps there are some properties of these "Virginia" Chemicals that you've overlooked. We shall welcome the opportunity of reviewing them in terms of your process, in your plant. **Industrial Department, VIRGINIA SMELTING COMPANY, Box 21, West Norfolk, Virginia.**

VIRGINIA Chemicals

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CHICAGO • ATLANTA • ASHEVILLE
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with the cross-sectional area being extruded. Also, running speed does not seem to vary appreciably over the extreme range of cross-sectional areas produced.

The plastic forming dies on the Glastruder can be made quickly and easily, are relatively inexpensive. And downtime for changeover from one die to another has been minimized. To sum it up—the machine can produce a wide range of cross-sectional shapes without major changes to the machinery and with low die cost.

The complete machine includes glass roving racks, carding device, resin impregnating tank, impregnating dies, die housing, r-f generator, the pulling device, automatic cutoff saw, structural members, supports and electrical conduits. About 7 kw. is required in either 220 or 240 v. to operate the ¾ hp. pulling motor and the 3 hp. saw motor. Also, low pressure air is used.

In its present form, the unit weighs 1,800 lb. and occupies floor space measuring 20 x 70 ft. However, it can be altered for mounting on a truck or trailer to follow a trenching machine, making and laying completely cured pipe.

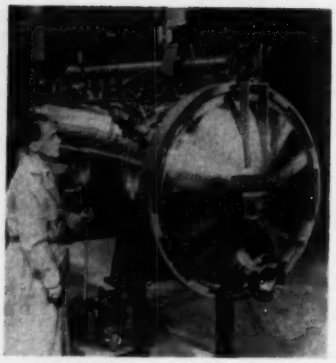
▶ **Looking Ahead**—Typical of the development work to provide an even wider market for Glastruder products is the effort focused on making suitable high pressure pipe. The present model produces tubing wall thicknesses from 0.030 in. to the maximum thickness that can be handled on the 3½x4 in. die. It is recommended only to 100 psi.

At higher pressures, the plastic material weeps i.e. finds pinhole escape through the glass fibers. A more satisfactory resin is in the offing with epoxies leading the parade.—**Glastrusions, Inc., 1335 Santiago Ave., Santa Ana, Calif.** 276A

For More Information . . .



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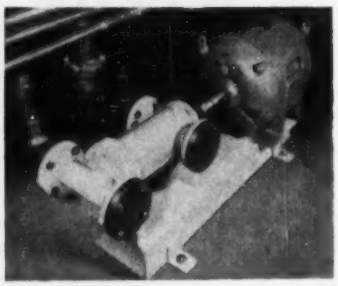
Filter Cover

Operated hydraulically, combines quick-opening and safety features.

Hydraulic operation of the cover now is included on the Niagara line of vertical and horizontal filters. The resultant uniform pressure makes for even seating and reduced wear.

A hydraulic pump transmits pressure to two hydraulic cylinders which rotate the locking ring. Resultant pressure of the cover against a gasket ring seals the filter securely.

On the horizontal filters the quick-opening hydraulically-operated cover is standard equipment; it is available at extra cost on the vertical units.—**Niagara Filters Div., American Machine & Metals, Inc., East Moline, Ill.** 278A



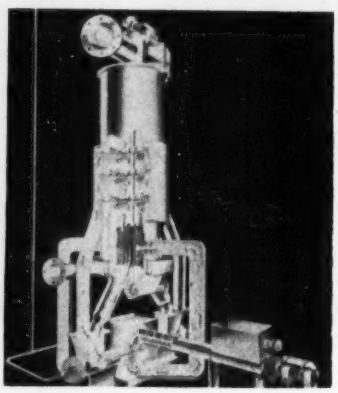
Disk Disperser

Emulsifies and disperses without heating by true shearing action.

A new disk disperser or colloid mill is claimed to make emulsions using less expensive raw materials. Use of knives revolving between perforated plates reduces material to fine consistency without generating heat. No cooling is needed.

Disperser is said to provide a better-looking, smoother product, produce improved product performance, increase yield, eliminate off-grade batches, develop shorter production cycles, save power and steam, increase plant capacity, permit use of lighter kettles for making heavier products and allow increases in batch size.

Disk Dispersers are completely self-contained; have an over-all size of 53x13x21 in. Drive is a 15 hp., 1,800 rpm. motor.—**Cazenovia Precision Machine Co., Inc., East Aurora, N. Y.** 278B



Pulverizer

Removes foreign particles ahead of active zone to up throughput.

Throughput rate has been boosted for the Jet pulverizer by incorporating a rock-stripper zone. Immediately after material enters the unit foreign particles of different specific gravity than the feed are stripped out.

Majac Jet pulverizers work on the principle of attrition between particles. Feed material is injected through opposing guns so that the particles collide with each other at high velocity. Machines can be used on a wide range of materials including limestone, iron ore, clays, graphite, feldspar, alumina, insecticides, fungicides, pigments and for exfoliation of fibrous solids.—**Majac, Inc., 23rd St. at P.R.R., Sharpsburg, Pa.** 278C

Dependable Source for Chemical Raw Materials



Thomas P. Brown (seated), technical vice president of Reichhold Chemicals, Inc., confers with Donald G. Patterson, manager of polyester sales and development.

"Wyandotte's raw-material research expedites our product research"

— Thomas P. Brown, Reichhold Chemicals, Inc.

Reichhold Chemicals, Inc., is one of the world's largest producers of synthetic resins, chemical pigment colors, and industrial chemicals. Started in 1927, in a small 4,000-square-foot plant in Ferndale, Mich., Reichhold Chemicals now has 31 plants throughout the world, and last year did a world-wide business of close to $100,000,000.

"Polyhydric alcohols are vital materials in the making of some of our most important resins," says Thomas P. Brown, technical vice president. "It is necessary that they conform to our rigid composition specifications. Consequently, our suppliers of chemical raw materials must maintain very high standards. We have found Wyandotte glycols and caustic soda reliable in this respect.

"Close collaboration with producers of basic raw materials expedites our own activities. Suppliers, like Wyandotte, who are continuously researching in their own area — basic raw materials — enable us to concentrate more of our own research on our own formulations and their applications."

Are you getting this cost-cutting collaboration from your chemical supplier? If not, it will pay you to talk over your needs with Wyandotte — a 64-year-old basic producer of organic and inorganic chemicals for business and industry. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine
Calcium Carbonate • Calcium Chloride • Glycols • Chlorinated Solvents • Synthetic Detergents • Agricultural Insecticides
Other Organic and Inorganic Chemicals



Pressure Balance

Rapidly and accurately measures precision pressures.

With the brashness of a comer the new type 37-103 precision pressure balance claims to obsolete the 300-year-old standard for precision measurement – mercury manometers. It overcomes disadvantages such as long response time, no convenient method of reading output, and necessary tube cleaning. Also the small, portable electronic instrument can measure pressure in locations formerly inaccessible.

Operating by dynamic force balance, the unit provides readings either as differential pressure, gage pressure or absolute pressure. It furnishes a laboratory standard for precise calibration of pressure pickups with accuracy comparable to the highest quality manometers.

A visual, digital readout counter with digits to 1,000 makes immediate readings possible. The instrument is designed so that readings can be held when required or attached to electrical tabulating devices through a built-in electrical analog d.c. output of 10 v.—**Consolidated Engineering Corp., 330 North Sierra Madre Villa, Pasadena 8, Calif.** **280A**

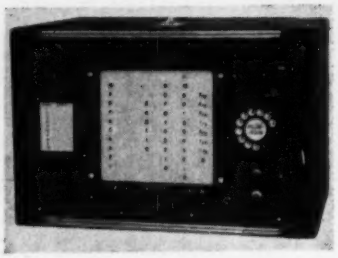
Indicating Amplifier

Increased reliability in measuring minute d.c. signals from instruments.

Minute d.c. signals from instruments such as strain gages, thermocouples, null detectors, mass spectrometers, photocells, vacuum, pressure and flow gages can be measured with increased reliability using the 2HLA-3 d.c. indicating amplifier.

Remarkable stability for low level measurements rests on use of a second-harmonic magnetic converter to replace the usual mechanical-vibrator type of converter. Signals as low as 2×10^{-16} w. can be amplified and measured. Gain is sufficient to drive the meter or a separate ink recorder.

Other features are extended frequency response up to 80 cycles per sec. with good linearity, and immunity to line voltage fluctuations and changes in ambient temperature.—**Doelcam Corp., 1400 Soldiers Field Rd., Boston 35, Mass.** **280B**



Telemetering System

Uses pulse code for error-free transmission.

In the Varec pulse-code telemetering system a pre-arranged code is used for each increment of intelligence to be transmitted. This is said to give error-proof transmission.

The transmitter portion of the system sets up the code for the particular value of liquid level, or other information, and transmits this to the receiver portion of the system.

At the receiver the incoming code is translated into the equivalent measurement increment. Each code is a distinct value. There are no borderline cases where the value may fall between two increments.

Incorporated in the system is a pulse counting feature that guards against error from incomplete signals. Unless the correct number of pulses are received no reading will show.

Varec pulse-code equipment can provide liquid-level alarms or warnings of other off-normal conditions at the remote control point. Also receiver output can be fed into printing equipment to give a permanent record of the gage readings, alarm warnings and other functions. Along with automatic printing, automatic sequencing can be added to make possible fully automatic gaging.—**The Vapor Recovery Systems Co., 2820 North Alameda St., Compton, Calif.** **280C**



Mass Spectrometer

Employs cycloidal focusing to extend sensitivity, accuracy and range.

Acclaimed as a significant advance, the cycloidal-focusing concept permits quantitative separation by mass spectrometry from mass 2 through 150—and scanning to mass 180.

Pen and ink recordings of the spectra show as peaks the distribution and relative quantity of ions resulting from conventional electron bombardment. In the cycloidal analyzer, peaks are sharply defined and interference from thermal energies is completely absent.

Cycloidal focusing of ions depends upon ion mass and the strength of crossed electric and magnetic fields. It is independent of the velocity or direction of motion of the injected ions.

The cycloidal focusing feature of the 21-620 mass spectrometer makes it possible to do things not previously possible with a small portable instrument. Gaseous and light liquid mixtures can be analyzed with high speed accuracy comparable to much larger instruments.

Earlier model 21-610 (*Chemical Engineering*, June '53, p. 256) can

Wagner®
ELECTRIC MOTORS
... the choice of leaders in industry

SAVE maintenance dollars with Wagner Fan-Cooled Industrial Motors



HERE'S HOW—

the Wagner Cartridge Bearing Design cuts your maintenance costs:

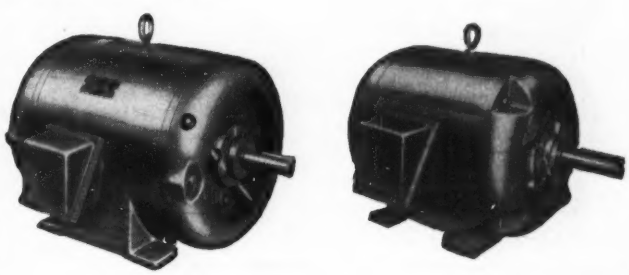
Bearings are protected at all times. The Wagner design completely encloses the bearings in a sealed cartridge. Labyrinth seals prevent the entrance of water, dirt and other foreign material. Even when the motor is disassembled, the cartridge remains intact as part of the rotor shaft. The bearing housing stays completely enclosed for full protection against dirt and dust.

Wagner Bearings can be relubricated. When lubrication is necessary to forestall premature bearing failure in unusually severe applications, readily accessible lubrication openings permit addition of grease or complete relubrication.

Wagner Bearings run longer between grease periods. Hot bearings shorten grease life. Wagner bearings have a low temperature rise because the design incorporates a deflector shield that directs a cooling stream of air around the bearing housing. Bearings run cooler and longer between maintenance periods.

This cartridge bearing design is a feature of the entire Wagner line of totally-enclosed fan-cooled motors. The line includes standard and explosion-proof steel frame motors, and standard and explosion-proof cast iron frame motors. All types are available with normal torque or high torque characteristics, in ratings to 250 hp.

For complete information—just call the nearest of our 32 branch offices, or write for Bulletins MU-132 and MU-196.



Wagner Electric Corporation EST. 1891

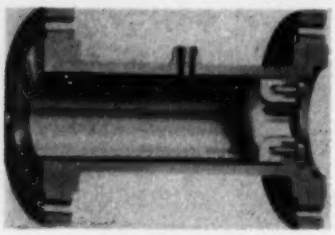
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ELECTRIC MOTORS
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AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

M54-16

be converted to its newer twin model 21-620 if the higher resolving power is needed.–**Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 8, Calif.** 280D



Gas Flow Meter

Using a newly adapted principle offers stable measurement and control.

With the Critiflo-Meter only one pressure tap is needed. Instrument measures and controls flow of steam and other gases, proportions and allocates steam to individual units or departments and proves out other flow measuring devices.

Simple construction of the Critiflo-Meter requires only two parts; a housing containing a nozzle of chrome carbide or hardened stainless steel and a flow indicator connected to the housing. If desired, the dial-type flow meter can be replaced by a controller or a recording pressure gage.

The pressure tap is on the upstream side of the nozzle. Pressure at this point is a direct indication of flow, provided the ratio of absolute pressure downstream from the nozzle (P_s) to absolute pressure upstream (P_1) is equal to, or less than, the so-called critical pressure ratio (R_c).

Under this condition, the fluid moves through the nozzle throat at sonic velocity. Any changes in downstream pressure have no effect on rate of flow so long as the critical pressure ratio is not exceeded.

The critical ratio for any gas or vapor can be calculated from the expression: $1/R_c = 0.61k + 1.040$ in which $k = C_p/C_v$.

Because of its simple construction, the instrument needs little maintenance; it can be installed in any piping system.

The meter can be furnished for pipe sizes from 2 to 10 in., for pressures up to 900 psi. and flow rates as high as 300,000 lb. per hr. of dry saturated steam.–**King Engineering Corp., Ann Arbor, Mich.** 282A

Heat Recorder

Measures and controls rate-of-heat input or output.

Fast, continuous measurement and control of rate-of-heat input or output is achieved with Dynamaster Btu. recorder-controller systems. Heat flow can be regulated for process vessels, refrigerating plants, air conditioners and a wide variety of other heat exchanging devices.

In the basic Btu. recording system, one Dynamaster measures the temperature difference with two resistance thermometers. At the same time it receives the flow-rate from a flow transmitter. Using the temperature and flow rate variables it continuously computes and records the Btu. transfer.–**The Bristol Co., Waterbury 20, Conn.** 282B

Vibration Control

Protects machines against damage from excessive vibration.

Operating independently without power source or special auxiliary equipment model 1 Vibraswitch is used for vibration measurement or as a protective device. Installed permanently on any rotating or vibrating machine it can prevent costly damage or material wastage when vibration becomes excessive.

At the most sensitive setting the device is actuated by vibratory displacement increases of less than 10 microinches. Flat frequency response from 0 to 200 cps. (12,000 rpm.) ensures reliable results on high speed equipment.

An internal SPDT snap switch can be wired into control circuits carrying up to 5 amp. to actuate a warning or shut down the machine the instant vibration exceeds normal by a preselected amount.–**The Beta Corp., P. O. Box 8625, Richmond 26, Va.** 282C

Differential converter transmitter measures liquid level in tanks under pressure or vacuum. A pneumatic force-balance weigh-beam system converts differential pressure into a proportionate air pressure that is transmitted to receiving indicators, recorders and controllers.–**Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Ave., Philadelphia 44, Pa.** 282D

Hygrometer determines relative humidity by measuring the electrical resistance of a carbon film. Time lag is less than one second at room temperature. Performance is essentially independent of temperature from 0 to 40 C.–**Arthur D. Little, Inc., 30 Memorial Dr., Cambridge, Mass.** 282E

Temperature controller for applications up to 600 F uses resistance type temperature bulb, has a.c. bridge design. Sensitivity of instrument, exclusive of bulb, is 0.005 F. Time constant is 4 sec.–**Hallikainen Instruments, 1341 Seventh St., Berkeley, Calif.** 282F

Remote indicators and recorders precisely follow the prime-mover dial of an automatic weigh scale. Standard accuracy is one part in 2,000. Instrumentation is built around a 60-cycle servo system; can be used with any industrial scale dial. Any number of indicators and recorders can be run by one prime mover.–**Richardson Scale Co., Van Houten Ave., Clifton, N. J.** 282G

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When you need welding fittings...



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GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

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Continuous chlorination . . .

. . . is the key unit process in Stauffer's method of making benzene hexachloride. Here's a pictured flowsheet that covers the entire operation. (p. 338)

Why push petrochemicals?

Take a look at this economic survey on petrochemicals: What they are, which are tops, where they go, why use petroleum, what the future holds. (p. 345)

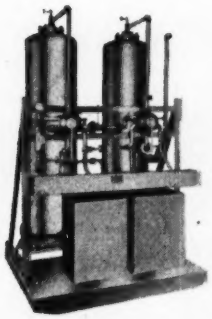
Have you voted yet?

You'll be interested in how others are voting on CE's new format and other changes. Pro & Con is our sounding board, your voting place. (p. 358)

New technical literature . . .

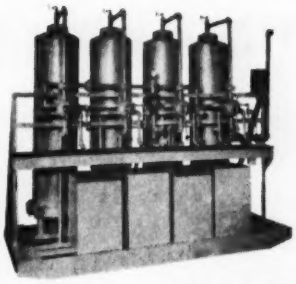
You can now get—free and fast—literature on any subject in your field. Keep your technical files up to date. (p. 476)

Join READER SERVICE on page 465



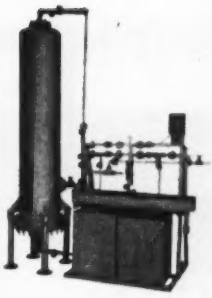
MODEL TM-5

Two-bed water demineralizer removing ionizable impurities at flow rate of 1000 gals. per hour. Other models from 30 gals. per hour. Shipped factory tested — complete with valves, piping, and controls.



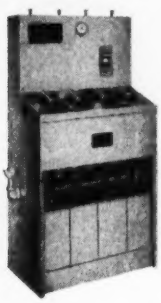
MODEL FM-5

Water demineralizer with flow rate of 1000 or more gals. per hour. More than twice the impurity-removing capacity of corresponding 2-bed models. Steel columns are lined with thick sheet rubber.



MODEL MM-4

Mixed-bed demineralizer. Standard equipment includes pressure gage, flow meter, purity meter, eductors, Uscolite piping, and regenerant tanks. Flow rates up to 2500 gals. per hour.



MODEL FR-2

Four-bed demineralizer produces pure demineralized water at flow rates up to 80 gals. per hour. Stainless steel cabinet. Gang-operated valves for exceptionally easy regeneration.



MODEL MM-1

Mixed-bed demineralizer with flow rate of 50 gals. per hour. Requires small space area. Exceptionally high-purity effluent. Lucite column permits resin visibility. A popular, practical model.

WATER DEMINERALIZERS

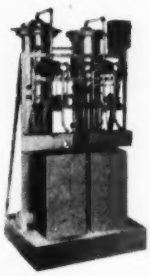
manufactured by BARNSTEAD are backed by more than 75 years of water purification experience and are made in sizes and models for every pure water need

ONLY BARNSTEAD

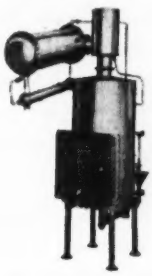
makes *both* water stills and water demineralizers

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Barnstead Demineralizer provides mineral-free feedwater to Barnstead Still



TM-3 Demineralizer



SSQ-100 Water Still

A demineralizer-water still combination is particularly advantageous when extremely pure water is needed in a location where hard water presents a scale problem. The demineralizer removes the scale-forming salts before the water enters the still. The still completes the purification task by removing the organic impurities, bacteria, and pyrogens. By teaming a Barnstead Still with a Barnstead Demineralizer, you will have one manufacturing responsibility for proper performance of both units . . . an important advantage for you.

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Air Reduction Sales Co., Dayton, Ohio
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Buick Motor Div. of F. M., Flint, Michigan
Canadian Laboratory Supplies, Toronto
Colombia Southern Chemical Co., Texas
Cudahy Packing Co., Omaha, Nebraska
Dewey & Almy, W. Concord, Mass.
Eastman Kodak Co., Rochester, N. Y.
Eithel-McCullough Company, Salt Lake City
Eugene Dietzgen Co., San Francisco, Calif.
Ford Motor Company, Detroit, Michigan
General Electric Co., Tell City, Indiana
Hard Chromers Inc., Bedford, Ohio
Hercules Powder Co., Cumberland, Md.
Hires-Turner Company, Washington, D. C.
Kings County Land & Cattle Co., Calif.
National Research Council, Ottawa
National Video, Chicago, Illinois
Perkasie Hosiery Co., Perkasie, Pa.
Pioneer Electronics, Santa Monica, Calif.
Polaroid Company, Cambridge, Mass.
R.C.A. Victo. Division, Harrison, N. J.
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Raytheon Mfg. Co., Lowell, Mass.
Remington Rand, New York, N.Y.
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Shell Development Co., Emeryville, Calif.
Shell Oil Company, Roxanne, Illinois
Squibb & Sons, Long Island City, N. Y.
Sylvania Electric Prod. Co., Salem, Mass.
Thompson Prod. Light Metals, Cleveland, O.
Trans World Airlines, Vandalia, Ohio
United Gas Pipe Line Co., Texas
Western Reserve Univ., Cleveland, O.
Wright Aeronautical, Woodbridge, N. J.
Wyeth International Ltd., Philadelphia, Pa.

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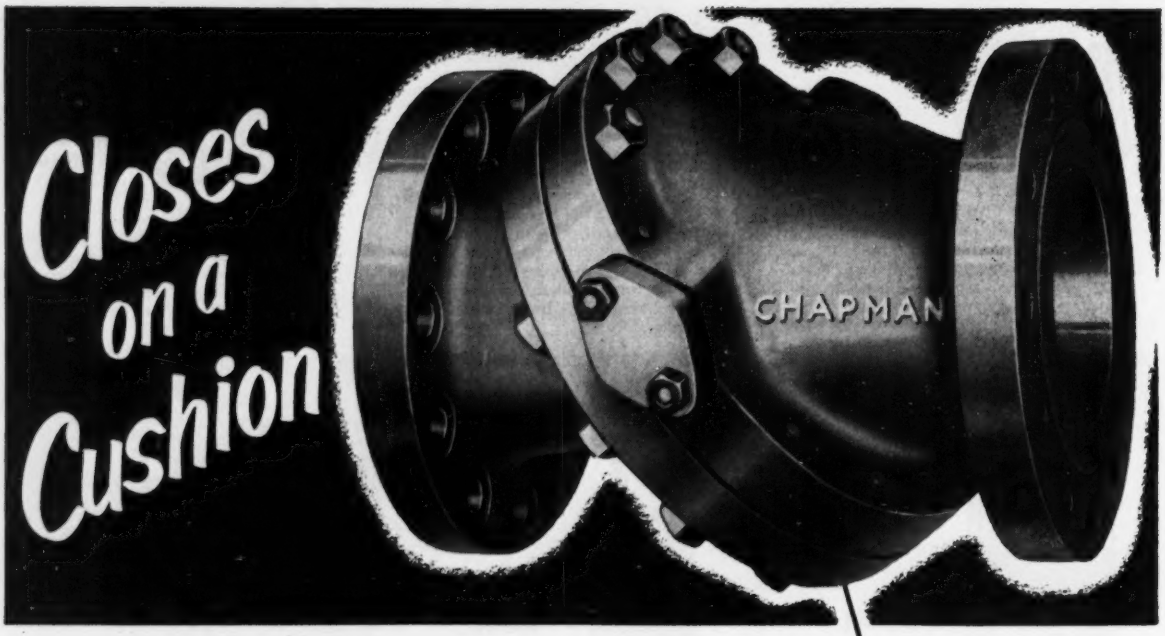
Barnstead STILL & STERILIZER CO.

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Barnstead engineers will gladly make recommendations for your plant, without cost or obligation

Chapman's Tilting Disc Check Valve

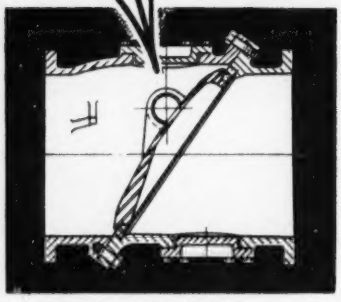


...for low cost, slam-free operation

Balanced pressures *cushion* the movement of the disc in Chapman's Tilting Disc Check Valve. The valve closes quickly but quietly, in all but unusual piping arrangements. There's no slamming to damage pipe-line joints or the valve itself. And *drop-tight* closure eliminates sliding wear on the disc and seat.

In the open position, the "airfoil" designed disc rides firmly against stops, without swinging or fluttering. That's why the hardened extra-large hinge pins give extremely long wear. And the absence of turbulence is one reason why head loss through Chapman's Tilting Disc Check Valve is lower than through any other type of check valve.

Low head loss, increased wear resistance and freedom from destructive slamming make Chapman's Tilting Disc Check Valves unbeatable for almost every installation. Write for Catalog No. 30 today.

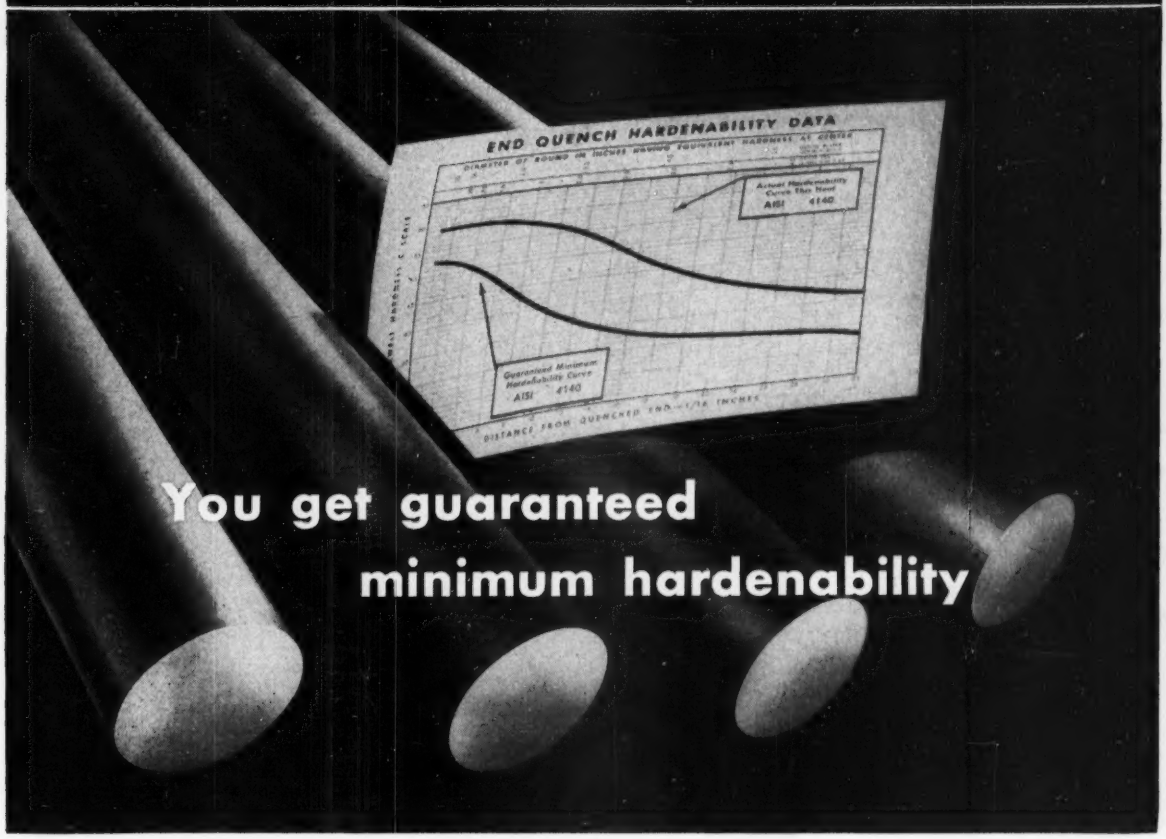


Here's why
CHAPMAN Tilting Disc Check Valves
***Keep Quiet* All Their Lives**

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

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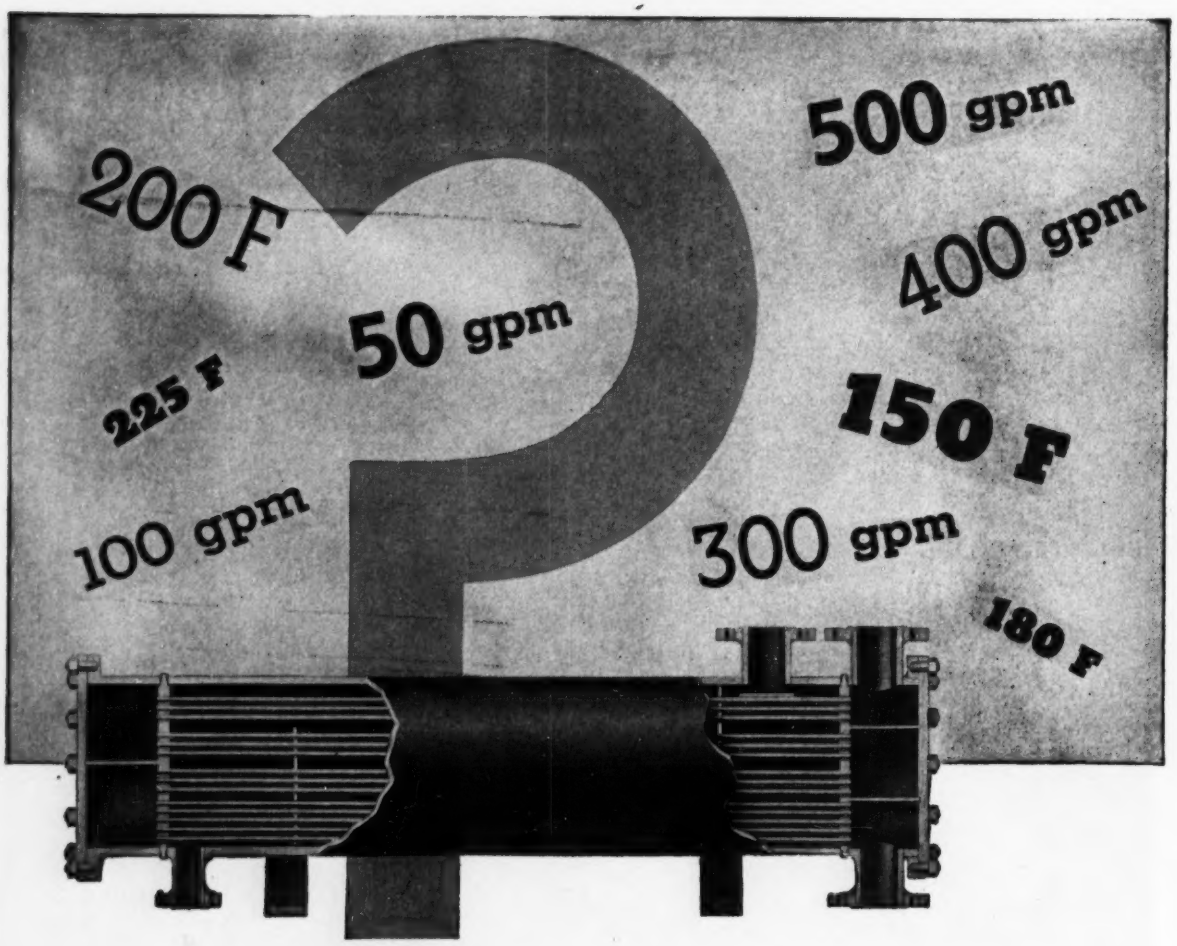
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A G-R Type B Heater will heat your fuel oil instantly to the correct temperature and in the quantity required for your burner.

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G-R HEAT TRANSFER APPARATUS **Type B Fuel Oil Heater**

GR 333



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"Century" Corrugated is made of two permanent, highly fire-resistant materials —asbestos fiber and portland cement— compressed under tremendous hydraulic pressure to make strong, tough sheets for almost every roofing or siding requirement. It can't burn, rot or corrode. What's more, it resists weather, vermin and insects. There's rarely a need for maintenance and it never needs protective paint. "Century" Corrugated Asbestos is low in first cost and low in application cost . . . easily sawed, drilled and fitted on the job.

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Here's what this new Hooker caustic soda plant at Montague, Mich., means to Midwest industry:

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Tighten up your caustic supply line now Many industrial leaders in the Midwest are already enjoying the convenience, economy, and dependable supply of Hooker caustic shipped from Montague.

You can have the same convenience and security *tomorrow*. Just pick up your phone and call us.



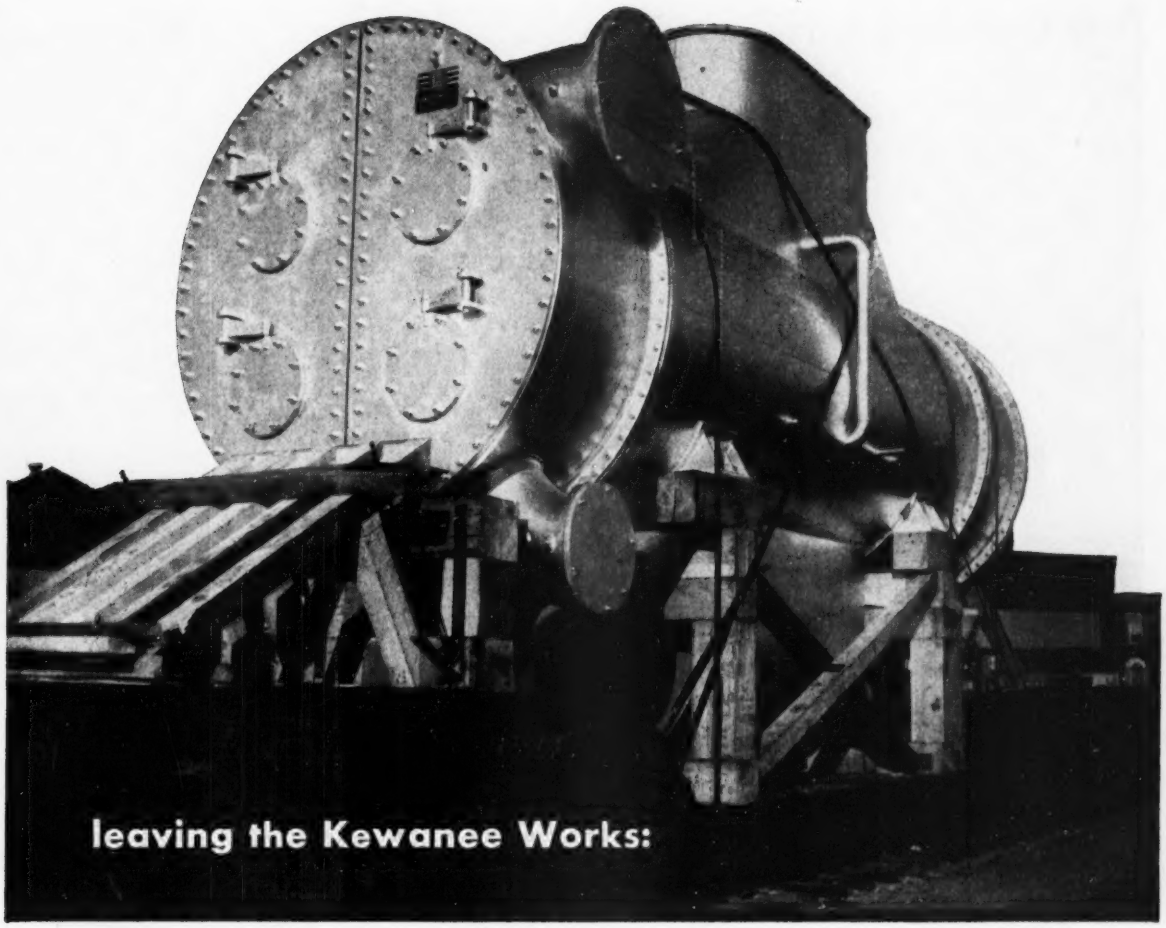
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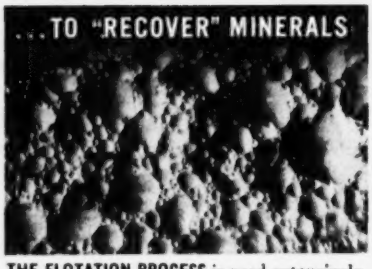


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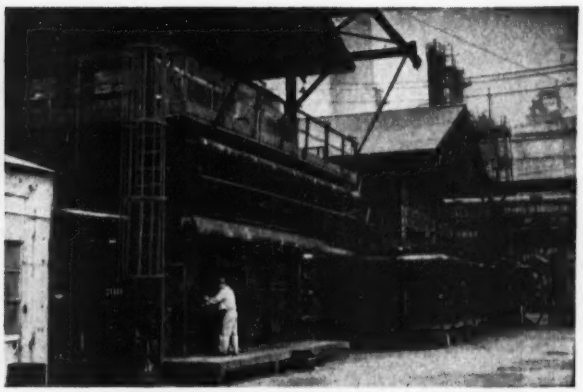
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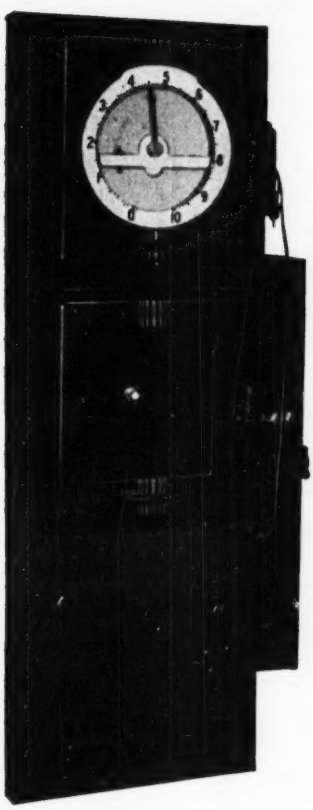


Typical plants where L&N oxygen recording equipment keeps total oxygen completely and accurately recorded, for more efficient combustion control.

Left: A steam central station (boiler furnace in rear) in an eastern utility. Right: A process heater in an eastern oil refinery.

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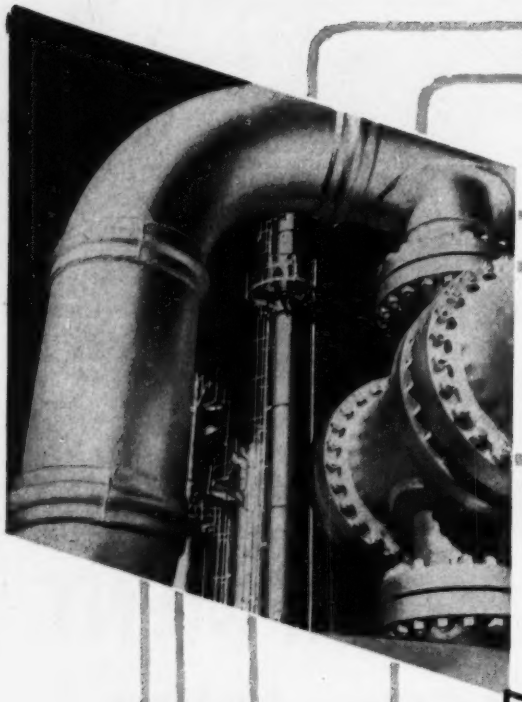
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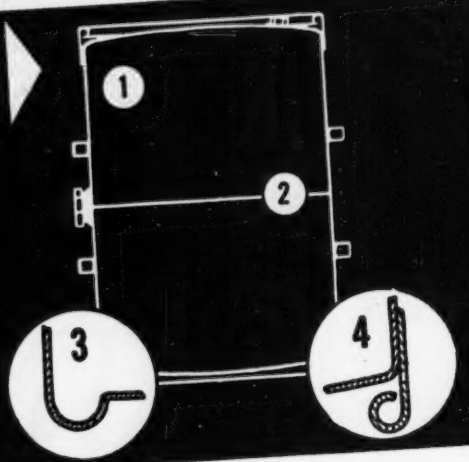
HACKNEY TWO-PIECE ACID DRUMS

...are designed to protect your shipments of corrosive and poisonous chemicals



INSIDE

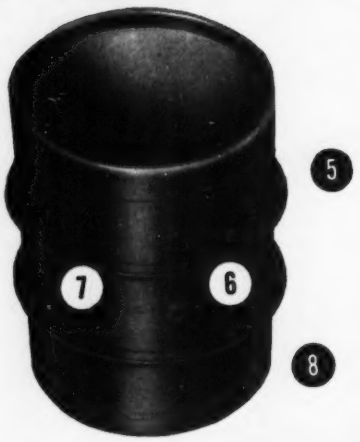
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3. Here is the seamless formed chime used on the 15-, 20, and 30-gallon sizes.
4. Here is the seamless, reinforced chime construction for the larger 55- and 110-gallon sizes.



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5. Sturdy I-Bar rolling hoops—protect the seam and spud against hard knocks.
6. Heavy, forged spud is firmly welded—becomes an integral part of the drum itself.
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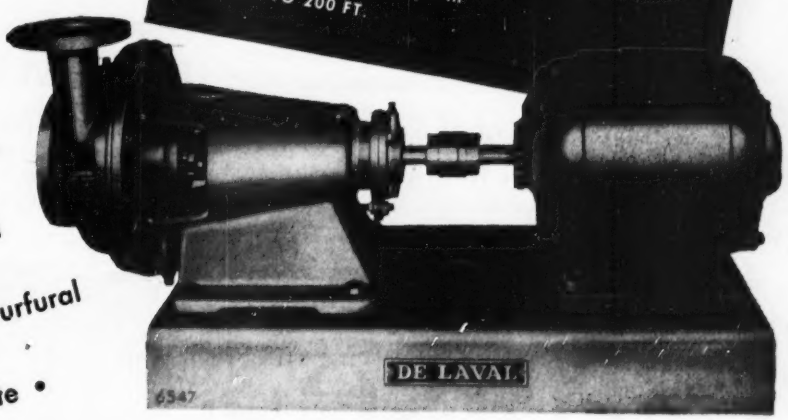
CONTAINERS FOR GASES, LIQUIDS, AND SOLIDS

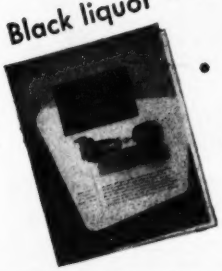
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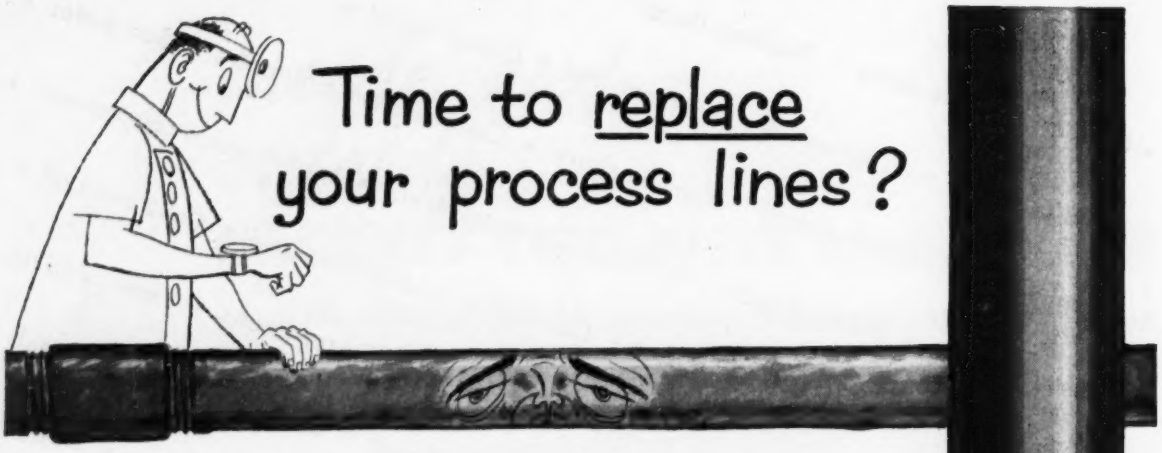


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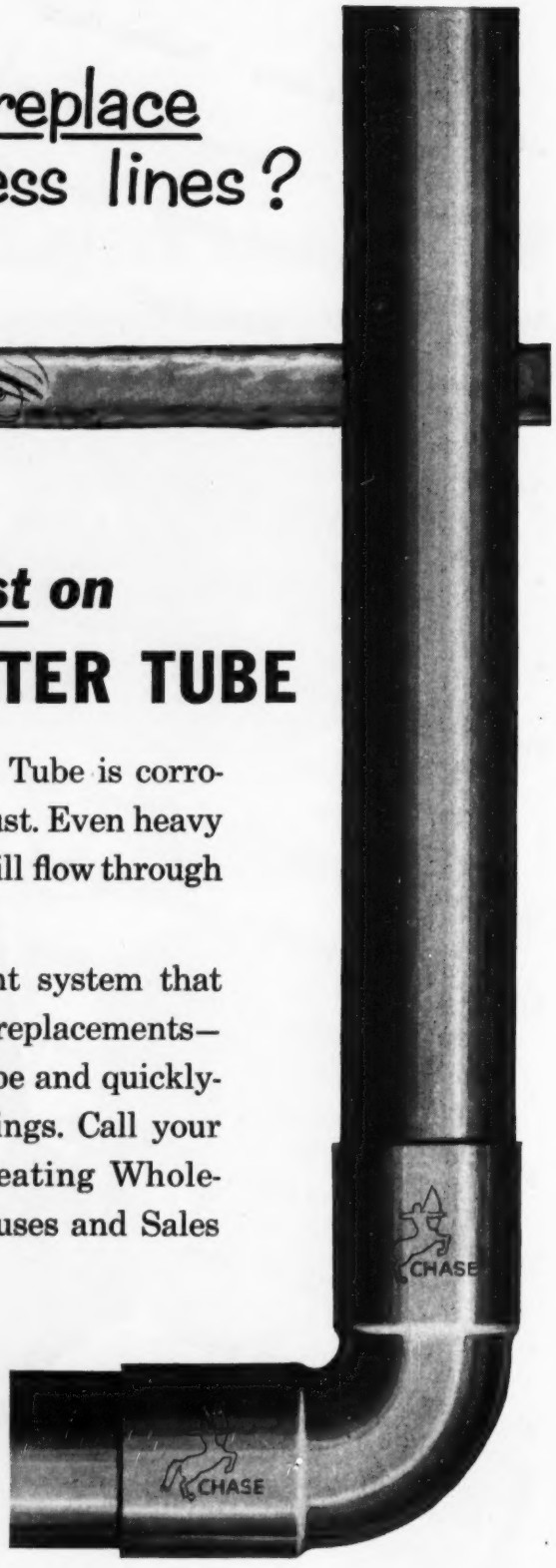
DE LAVAL STEAM TURBINE COMPANY
803 Nottingham Way, Trenton 2, New Jersey

WRITE FOR BULLETIN 1125-B

DL 283



Time to replace your process lines?



This time, insist on

CHASE® COPPER WATER TUBE

Here's why: Chase Copper Water Tube is corrosion-resistant. It can't clog with rust. Even heavy industrial fluids like paper pulp will flow through it cleanly, smoothly.

For a leak-proof, pressure-tight system that will save you costly repairs and replacements—insist on Chase Copper Water Tube and quickly-installed Chase Solder-Joint Fittings. Call your nearest Chase Plumbing and Heating Wholesaler or one of the Chase Warehouses and Sales Offices listed below.

Chase®

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

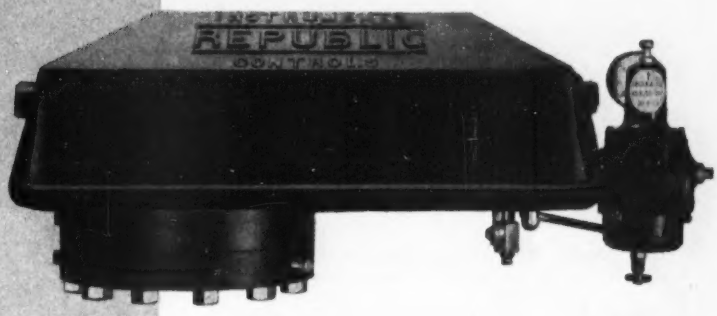
The Nation's Headquarters for Brass & Copper

Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

COMBINES MACHINE RUGGEDNESS WITH INSTRUMENT PRECISION for dependable low maintenance metering

REPUBLIC

pneumatic transmitter for measuring FLOW, PRESSURE, LEVEL or DENSITY...



Machine dependability with instrument accuracy and sensitivity! Think what this combination of features can mean in your plant—less maintenance, longer life for lowest "long run" cost, *continuous* accurate operation.

You get all of these benefits and more with the Republic Pneumatic Transmitter. Force-balance operation permits the use of strong rugged parts with no sacrifice in accuracy or sensitivity. Gives exceptional overrange protection.

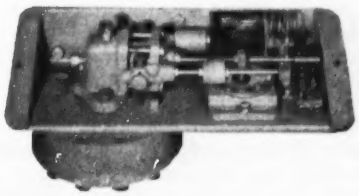
Housed in a durable metal case, the transmitter may be adjusted for mounting at any angle, indoors or out. Its accuracy is not affected by changes in ambient temperature vibration, normal changes in supply air pressure or inaccurate leveling. Uses no mercury or purge pots. Can be used with very viscous fluids.

The Republic transmitter isolates fluids to a measuring chamber which may be supplied in a variety of corrosion resistant materials. It sends an air pressure proportional to fluid flow, pressure, level or density to reading instruments or for actuation of an automatic controller.

Republic Pneumatic Transmitters are proving their superiority in hundreds of chemical and oil field applications. Investigate their advantages for you — write for your free copy of 36 page Data Book No. 1004.

SPECIFICATIONS:

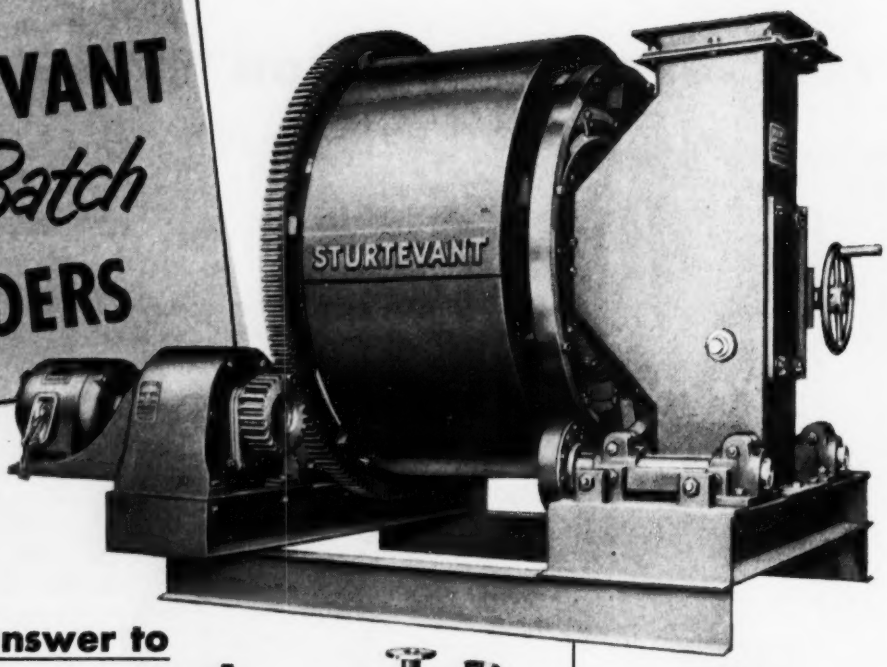
ACCURACY — ½% of maximum range guaranteed for standard models.
DIFFERENTIAL RANGES — Any desired span between 0-0.6" H_2O and 0-750 psi at operating pressures of 15 psig to 2000 psig.
PRESSURE RANGES — Any desired span between 0-1" H_2O and 0-2000 psig.
LEVEL RANGES — to meet almost any application.
DENSITY RANGES — 0.15 sp. gravity spread for 3 to 15 psig output pressure from any base density.
Extremely wide range change is possible without change of parts. Ranges may be easily changed, suppressed, compounded or reversed.



● ***EASILY SERVICED*** Cover can be completely removed for access to all range adjustments and replaceable parts. No special tools required.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

STURTEVANT *Dry Batch* BLENDERS



are the answer to

Fast, Economical Mixing

Because of the unique design of its mixing chamber, and the 4-way mixing action which brings two or more substances together, the Sturtevant Dry-Batch Blender does a more rapid mixing job than other machines and, at the same time, it is complete and thorough in every particular. The substances may be of different weights and physical properties, and may be either dry, partly dry, or a mixture of both. Write for bulletin today.

Compare These Advantages

- Only one lever controls both receiving and discharging for simplicity of operation. Hand wheel operates rack and pinion slide at feed opening.
- 4-way mixing action speeds production . . . assures thorough blends.
- "Open-door" accessibility permits easy, fast, thorough cleaning.
- Single aperture drum for both intake and discharge.
- Unusually efficient scoops pick up materials to effect thorough mixing as drum revolves.
- 9 models . . . a size for every job . . . from 10 cu. ft. to 900 cu. ft. batches.

STURTEVANT MILL COMPANY

100 Clayton Street, Boston 22, Mass.

DESIGNERS & MANUFACTURERS OF

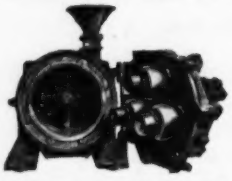
CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS
MECHANICAL DENS AND EXCAVATORS • ELEVATORS • MIXERS



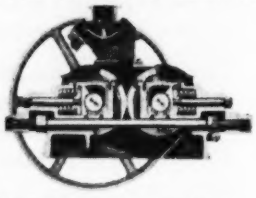
Micronizer® Grinding Machine. A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired. Available for outright sale.



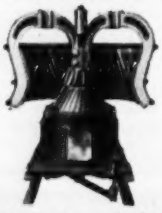
Air Separator — for separation of fines to 325 mesh and finer. Increases output from 25% to 300% . . . lowers power costs by 50%. Capacities ¼ to 50 tons per hour output.



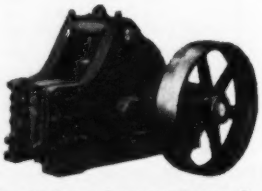
Ring-Roll Mills — for medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operated in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.



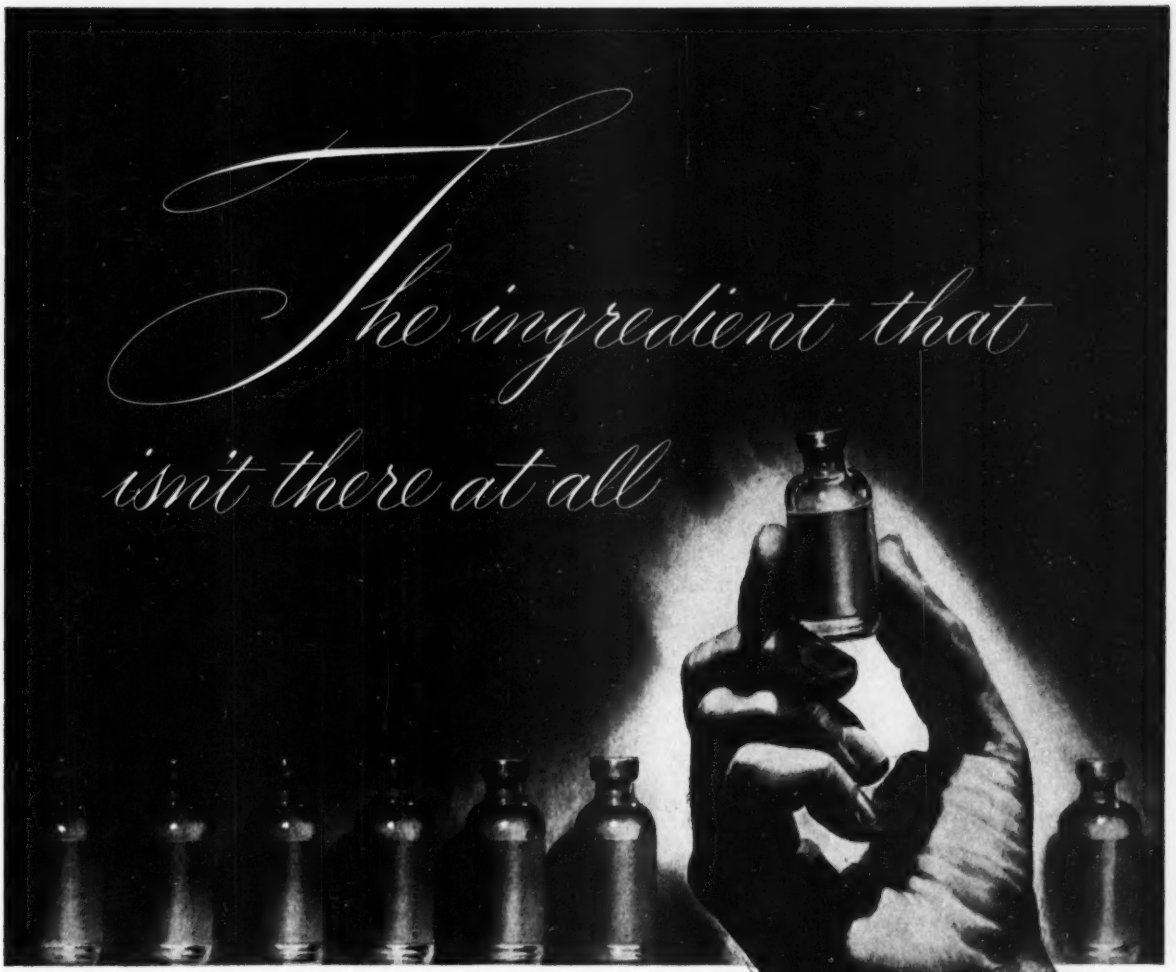
Crushing Rolls — for granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8 x 5 to 38 x 20. The standard for abrasives.



Rotary Fine Crushers — for intermediate and fine reduction (down to ¼"). Open door accessibility. Soft or moderately hard materials. Efficient granulators. Excellent preliminary Crushers preceding Pulverizers.



Jaw Crushers — for coarse, intermediate and fine reduction of hard or soft substances. Heavy or light duty. Cam and Roller action. Special crushers for Ferro-alloys. Several types, many sizes.



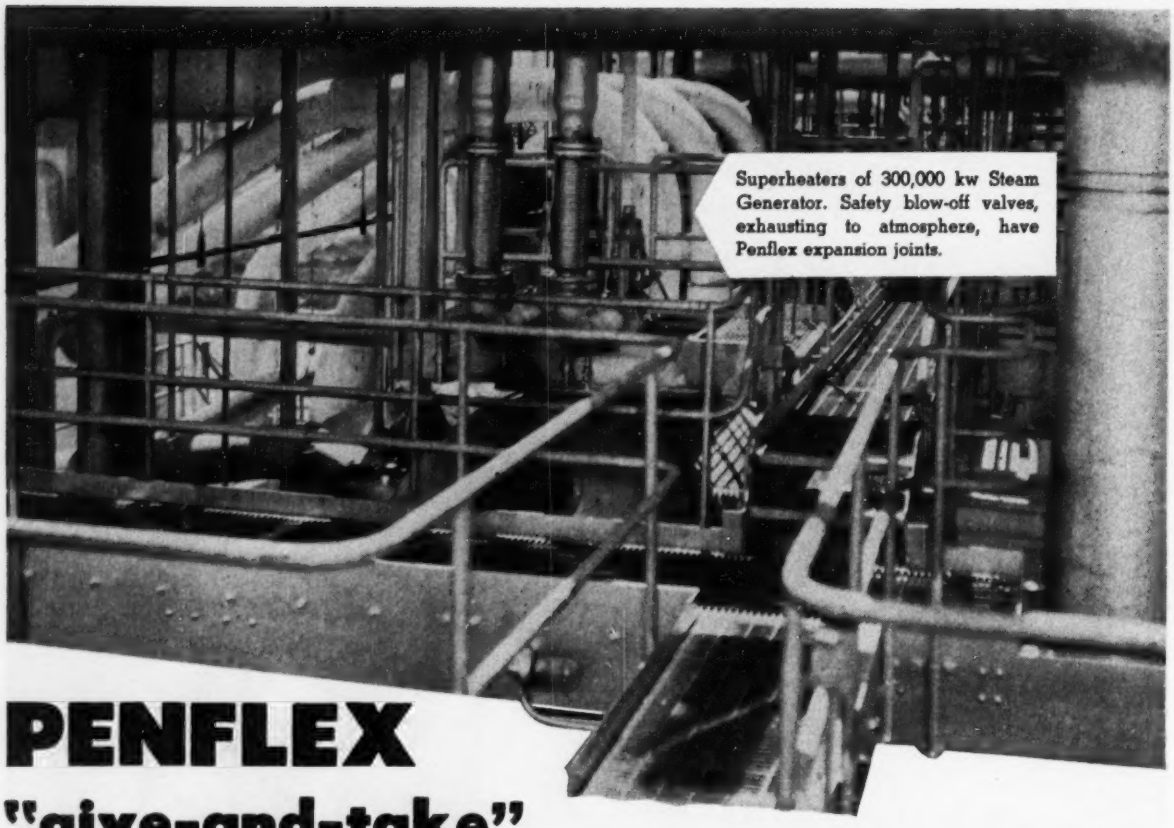
CAN MAKE POSSIBLE THE GIFT OF LIFE ITSELF

In all the glamour stories on the "miracle drugs"... penicillin, streptomycin, aureomycin, terramycin, to name the most familiar ones... there is no single word about *diatomite* – nor can you find the slightest trace of diatomite in the life-saving drugs themselves. Yet the ingredient that isn't there at all, diatomite, plays a vital role in antibiotic production, for, as a filteraid, it gives filtration "sharp" enough to remove all unwanted solids, even those in the submicron range.

Dicalite is the trade name of diatomaceous materials produced by the Dicalite Division of Great Lakes Carbon Corporation. We are proud of the part it has played, and is playing, in producing a number of these "wonder drugs." Because of its purity, its uniformity and its chemical inertness, Dicalite is helping to push forward the frontiers of scientific progress in this and in many other fields. Its uses, even today, are too numerous to list here, and new applications are discovered almost every week.

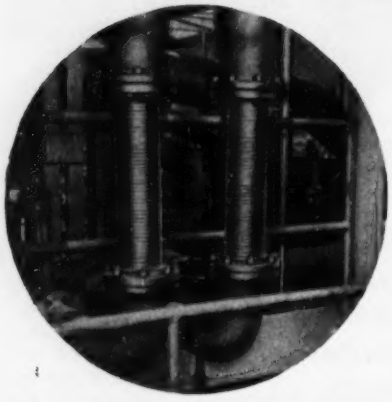
Dependable
GLC GREAT LAKES **Dicalite**
DIATOMACEOUS MATERIALS

For complete information on Dicalite—diatomaceous filteraids, for example—please write for Bulletin B-12. Dicalite Division, Great Lakes Carbon Corp., 612 S. Flower St., Los Angeles 17, Calif.



Superheaters of 300,000 kw Steam Generator. Safety blow-off valves, exhausting to atmosphere, have Penflex expansion joints.

PENFLEX "give-and-take" prevents blow-outs on blow-offs



Penflex Galvanized Steel Interlocked Tubing (8" I.D.), flanged at both ends. Installed as expansion joints on safety blow-off valves, they take up to 850 psi steam pressure at 900°F.

Power plant applications like this one can't use less than Penflex Metal Tubing offers in flexibility, strength, and tightness. When safety valves go, expansion joints must hold. Penflex joints *do*. That's because they can give with the pressure and take it, too.

Thermal expansion at 900°F. . . . pressures up to 850 psi . . . impact and pipe movement under these strains—all are safely handled by Penflex. Forty-two complete units in this big power plant are protected from blow-outs by Penflex.

There are hundreds of other applications in the steam and diesel power fields for Penflex Interlocked Tubing and Penflexweld High-pressure Tubing. Call in the Penflex engineer to help you on your own particular problems. In the meantime, write for "Flexineering," your guide in buying and using Penflex Flexible Metal Tubing. There is no charge or obligation.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7234 Powers Lane, Phila. 42, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles and Distributors in Principal Cities**



COMBINES FLEXIBILITY WITH DURABILITY

When you have trouble handling

Chlorine
Bromine
Fluorine

. . . or their compounds

When you have a corrosion or purity problem connected with the handling of halogens or halides, consider the use of the Inco Nickel Alloys. They are among the few metallic materials which are successfully used to resist corrosion by chlorine, bromine, fluorine and their halides.

Chlorine—Tests as well as practical experience have shown nickel and the high-nickel alloys to be among the most useful of the common engineering materials for handling dry chlorine at temperatures up to 1000°F.

Bromine—The high resistance of Monel shipping drums to dry bromine has enabled bromine manufacturers to ship this dangerous corrosive in original purity, without fear of contamination or breakage, while cutting shipping costs in some cases by as much as 50%.*

Fluorine—Because nickel and Monel are highly resistant to ignition by fluorine, they are preferred materials for storage cylinders, piping and valves when handling fluorine under pressure.

Sodium Chloride—Potassium Chloride—Manufacturers rely on Inco Nickel Alloys to help preserve product purity during the entire refining operation. High-nickel alloys are counted on to assure long service life for such equipment as brine storage tanks, pumps, valves, filters, evaporators and driers.

Hydrogen Fluoride and Hydrofluoric Acid—Monel is more widely applicable to the handling of anhydrous HF and hydrofluoric acid solutions over a wide range of temperatures and concentrations than any other alloy.

Magnesium Chloride—Because Inconel is free from stress corrosion cracking in boiling magnesium chloride solutions, it has been accepted as a standard material for evaporating magnesium chloride.

Calcium Chloride—For long service life, nickel and Monel linings and flights are used in the large gas-fired rotary driers where wet calcium chloride contacts furnace gases.

Aluminum Chloride—Where aluminum chloride is employed as a catalyst, Monel reaction vessels and piping are often used to resist corrosion from dilute hydrochloric acid formed as a result of hydrolysis.

If your operations with halogens or their compounds seem to indicate the desirability of employing one of the Inco Nickel Alloys, it will be advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

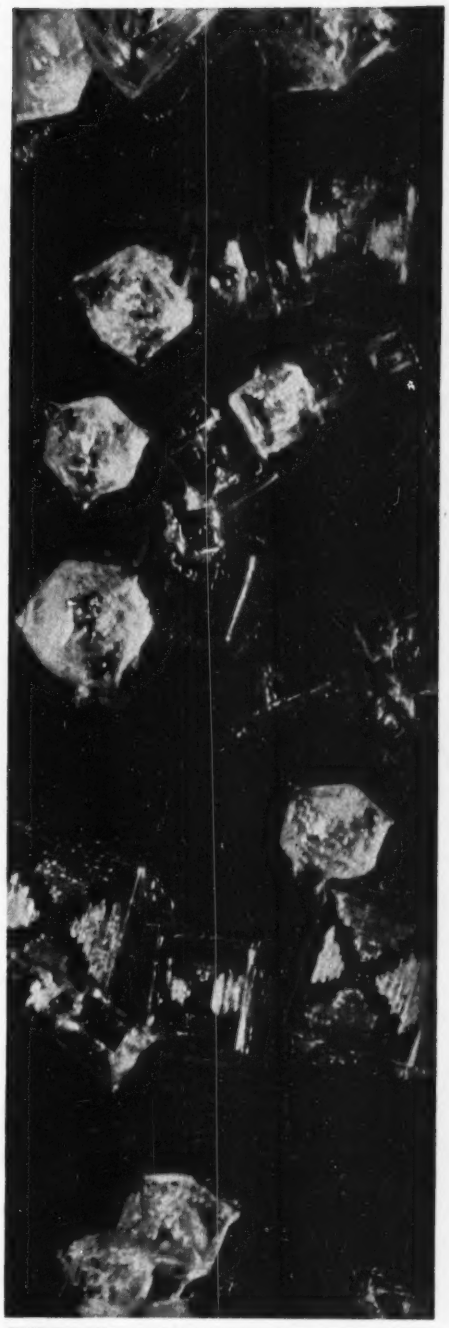
*Other materials which are shipped in nickel drums include: acetyl chloride, benzyl chloride, benzoyl chloride, pyrosulfuryl chloride, thionyl chloride, phosphorus trichloride, phosphorus oxychloride, and thiophosphoryl chloride.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, New York

Inco Nickel Alloys

INCO TRADE MARK

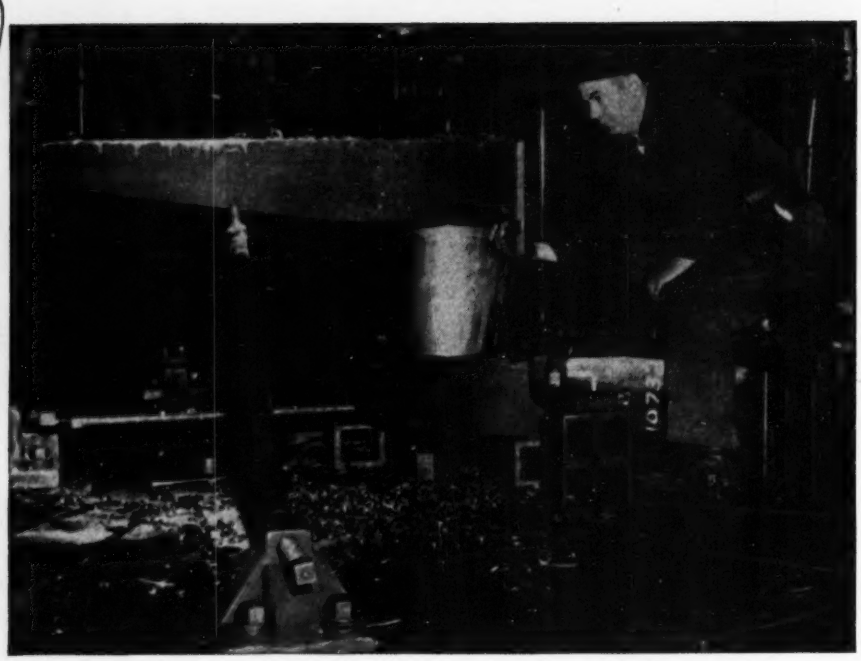
MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL
"S"® MONEL • INCONEL® • INCONEL "X"®
INCONEL "W"® • INCOLOY® • NIMONIC® ALLOYS
NICKEL • LOW CARBON NICKEL • DURANICKEL®



Inorganic Acid Chlorides in Which Satisfactory Uses of Monel and Nickel Have Been Recorded

Corrosive Media	Monel	Nickel
Aluminum Chloride	Yes	
Ammonium Chloride	Yes	Yes
Antimony Chloride	Yes	
Arsenic Trichloride	Yes	Yes
Magnesium Chloride	Yes	Yes
Manganous Chloride	Yes	
Nitrosyl Chloride	Yes	Yes
Phosphorus Oxychloride		Yes
Phosphorus Trichloride		Yes
Silicon Tetrachloride		Yes
Sulfur Monochloride	Yes	Yes
Sulfuryl Chloride	Yes	Yes
Tin Tetrachloride	Yes	Yes
Titanium Tetrachloride	Yes	
Zinc Chloride	Yes	Yes





The chips that talk...

To the native savage, whose tribe had no conception of a written language, the piece of wood on which the explorer scribbled a message became the wonderful "chip that talks."

The chips of metal that pour in silver drifts from the mighty machines in Sun Ship's Wetherill plant tell their stories, too. Those shown on the 14-foot boring mill tell part of the story of a fast, thorough repair job on ship-propulsion machinery. That job required lifting a 54-ton section of crankshaft from the ship to a 10 ft. x 50 ft. engine lathe, where it was checked for trueness and the journals machined. The crankpins were machined in a huge crankshaft machine. The boring mill operation shown was the facing of the webs of a new section which replaced one of the damaged sections of the crankshaft.

That's the kind of story the versatile men and machines at Sun Ship have been writing for decades . . . in building special machinery of every type for the varied industries that are building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE — SINCE 1916 — CHESTER, PA.

25 BROADWAY • NEW YORK CITY



AFTER 100 YEARS

...moving gas and air is still our ONLY business

From the simple Rotary Positive Blower which we developed and started building 100 years ago, Roots-Connersville equipment now includes both Rotary Positive and Centrifugal units (the only *dual-ability* line in the industry), gas pumps, meters, vacuum pumps, inert gas generators and our latest 1953 development, the amazingly efficient Spiraxial Compressor. With the exception of the Spiraxial, the youngest members of the family are centrifugals, now 23 years old.

Yet in this century of rapid changes, with industries shifting from one product to another, Roots-Connersville has consistently adhered to one line of thought and action—the production of the most economical and reliable equipment to handle gas and air. We think this policy has "paid off"—not only to us but to our thousands of customers who, by their many repeat orders, testify to the high quality of R-C products. Perhaps one reason is that although old in years, we are young in ideas to meet technological changes in manufacturing processes.

So, we suggest you consult us when you are considering equipment to move gas or air. You will find that our 100 years of specialized experience can pay you substantial and continuing good dividends.

Reg. U.S. Pat. Off.

BLOWER BUILDERS SINCE 1854

ROOTS-CONNERSVILLE BLOWER A DIVISION OF DRESSER INDUSTRIES, INC.
1054 Michigan Ave. • Connersville, Indiana

T F

They don't come too big for TAYLOR FORGE

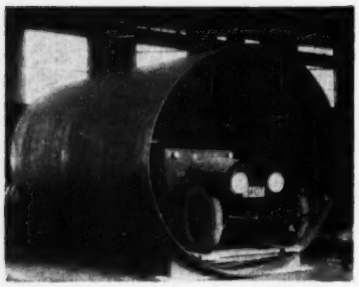
As pioneers in the making of heavy-walled large-diameter pipe, it is not surprising that Taylor Forge has developed the widest range of large welding fittings and flanges like those illustrated here.

In fact, those who know the background of Taylor Forge insist on the WeldELL® line for all requirements from smallest to largest. They have found that WeldELLS have features which are combined in no other fittings for pipe welding.

See your Taylor Forge Distributor for up-to-the-minute facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS • General Offices and Works: P.O. Box 485, Chicago 90, Illinois • *Offices in all principal cities* Plants at: Carnegie, Pa.; Fontana, Calif.; Gary, Ind.; Hamilton, Ontario, Canada



The pipe was farther along than the auto!

They made their automobiles high in the days when this photo was taken at the old Taylor Forge Works, and that's why Taylor Forge chose this way of demonstrating the largest heavy-walled pipe the world of 1916 had ever known.

As a matter of fact, the pipe was farther along than the automobile; for Taylor Forge had started the manufacture of this large pipe as early as 1907. Before then, pipe had been just a tube for conveying fluids, but by 1907 there was a widespread call for large, rated pipe to withstand widely varied and exacting services.

Taylor Forge responded to this call. In pioneering forged steel flanges, Taylor Forge had learned a lot about forging technique and piping practice...and both schoolings were prerequisite to the new venture. The projected large diameter pipe was to consist of heavy plate rolled into shape, then hammer lap welded to a smooth, sound weld. This called for heavy, specially designed equipment to make the process work and to provide the first *smooth interior* pipe and pressure vessel cylinders produced in this country.

Typical of the pioneering obstacles was the need for a clean flame to prevent scale forming at the weld, but this problem was solved when Mr. J. Hall Taylor designed and installed a large water gas plant that provided the desired welding conditions.

Thus it was that by 1916 Taylor Forge was making pipe up to 96"; forging all types of end joints on it; engineering it and prefabricating it into hydro-electric penstocks; laterals and Y's for pumping stations, pipe lines, and for similar applications all over the world.

Since the introduction of automatic metallic arc-welding this large pipe has been produced as "Taylor Straight Seam Electric-Weld Pipe," but there are hundreds of miles of the old "Taylor Hammer Lap Welded Pipe" still giving as good service as it did the day it was installed.

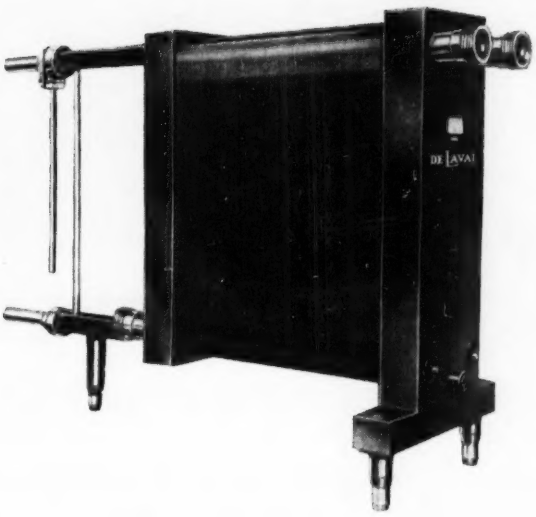
An episode in the story of Taylor Forge leadership in designed piping

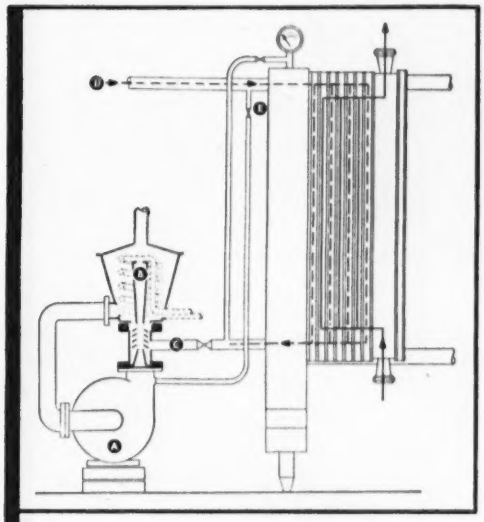


This old painting—the original in full color—depicted the original process of making Taylor hammer lap welded pipe.

NOW!

"PIN-POINT" TEMPERATURE CONTROL IN PROCESSING LIQUIDS...





Shown above is a diagram of the De Laval Vacuum-Steam Heating System. Connecting with the steam side of the plates in the heating section is a vacuum apparatus consisting of centrifugal pump (A) which circulates water through water jet (B) in circulating tank. Jet is connected to condensate outlet (C) so that jet suction creates vacuum in heating section. This causes steam entering the unit (D) to expand to degree of vacuum thus created, and the temperature of the steam to be lowered to the desired point. Expanding steam is prevented from becoming super-heated by saturating device (E).

For heat exchanger processing—where precise control of heating medium temperature is demanded *—no technique can match the accuracy of a De Laval Vacuum-Steam Heating System with De Laval Heat Exchanger.*

This De Laval system provides positive "hair trigger" response to each call for temperature change . . . practically eliminates time lag . . . avoids any possibility of "burn on" . . . holds the "split" between heating medium and product temperatures to extremely close limits.

The diagram at right shows how the basic principle of the De Laval system assures a uniform product quality never before achieved.

Today . . . write for complete details about the De Laval Vacuum-Steam Heating System and De Laval Plate Heat Exchangers. There are no finer.

DE LAVAL
PLATE HEAT EXCHANGERS

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York ● 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5

Cut your inventory with

CELANESE* DOUBLE DUTY P.E.
(PENTAERYTHRITOL)



IF YOU NEED TO MEET PURE GRADE SPECS
Celanese P.E. has met the highest specs. Through "continuous" process, Celanese P.E. is high in hydroxyl value, uniform in mono content, low in ash. Ideal for high phthalic content resins.

IF YOU NEED TO MEET TECH GRADE COSTS
Celanese P.E. costs no more than ordinary tech grades. It can shorten cooking cycles, make filtration easier, produce a lighter color resin in the low-price field.

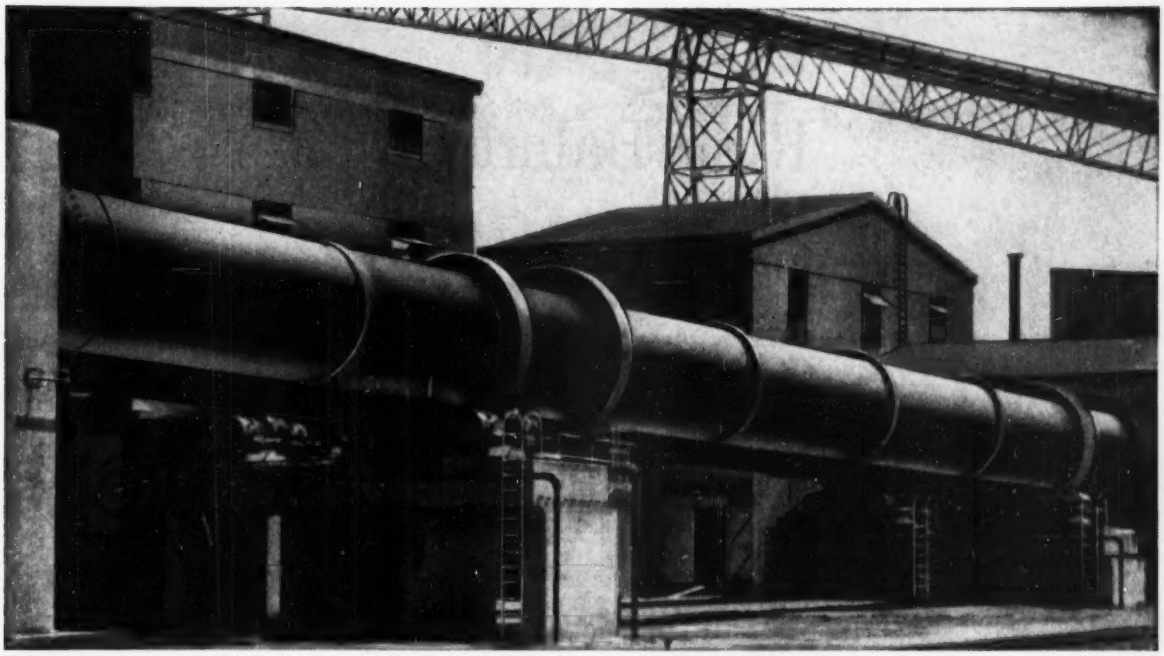
With the spotlight on inventories, Celanese P.E. answers the need of alkyd resin manufacturers for a pentaerythritol that qualifies for every application. The new Celanese P.E. bulletin can give you the complete story, backed by formulations, tests, comparisons and cost analyses. Write to Dept. 553-J Celanese Corporation of America, Chemical Division, 180 Madison Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off.

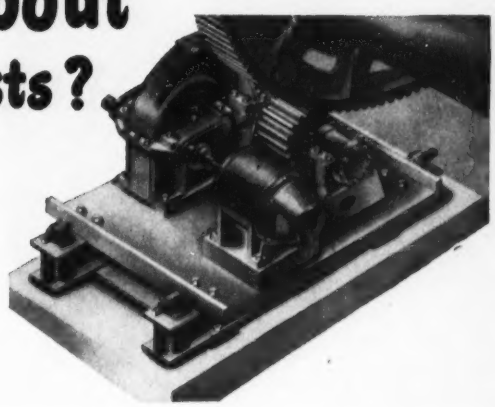


HIGHER PURITY P. E. IS THE RESULT OF CELANESE "CONTINUOUS" PROCESS

Celanese* CHEMICALS



Are you concerned about high thermo-processing costs?



Then it's time to replace inefficient machines with Traylor Rotary Kilns

Traylor Rotary Kilns have many exclusive features which were developed over the past 50 years on the basis of field experience.

Solid cast steel floating riding rings, which are mounted on machined blocks, insuring a perfect fit. This eliminates uneven wear which causes weak spots that result in expensive maintenance.

Kiln drive is completely mounted on a sole plate which is fully adjustable as a unit to insure perfect alignment and easy adjustment of main gear and pinion.

Secondary air is utilized to obtain maximum heat efficiency from every B.T.U. This Traylor feature achieves amazing thermo-processing economies.

The success of Traylor Rotary Kiln design is best emphasized by the large number of customers who have returned time after time for additional Traylor Kilns. Send for Bulletin 115 which gives all the points of Traylor superiority.

a **Traylor** *leads to greater profits*

TRAYLOR ENGINEERING & MANUFACTURING CO.
691 MILL ST., ALLENTOWN, PA.
SALES OFFICES: New York • Chicago • San Francisco
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.

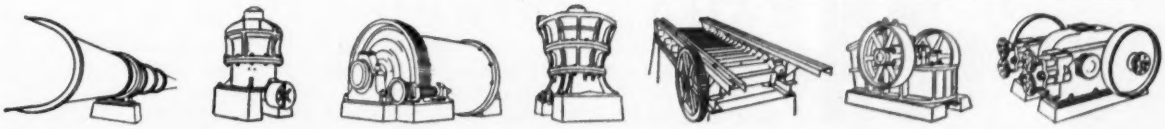
Send 8 page catalog on Traylor equipment for the process industries.

Name: _____

Position: _____

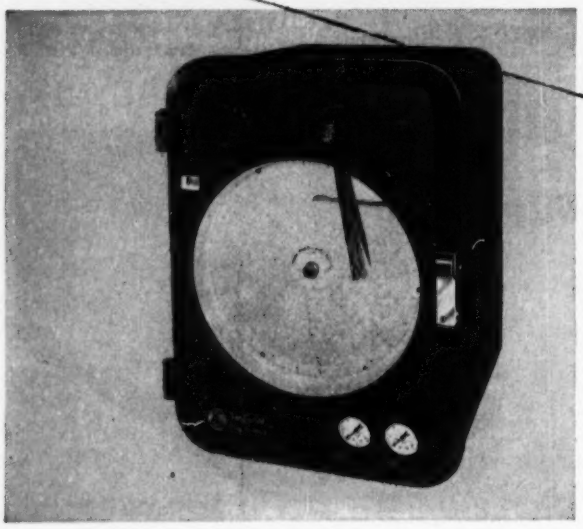
Company: _____

Address: _____ State: _____



HAGAN

Ring Balance Meter *beats the high cost of* Permanent Pressure Loss!



It works out like this:

Using an Expensive Primary Element . . . 10% of 100″ full scale differential is *10″ PPL*

Using a Low Cost Primary Element . . . 50% of 6″ full scale differential is *only 3″ PPL*

The Hagan Ring Balance Meter is particularly adapted for accurate operation at full scale differentials as low as 1″ WC, with *any* type of primary element. In many applications, by choosing a low cost, low differential element, with a PPL of 50% or more, and measuring the flow with a Ring Balance Meter, the actual permanent pressure loss is low. In the example shown above, *it is only a third of the actual PPL* sustained with a high cost, high differential primary element. Here is positive, long range economy . . . lower pumping costs result from reduced horsepower requirement.

This is an example of how Hagan experience and engineering skill can reduce costs. Hagan engineers will be glad to recommend the most economical solution to your metering problem.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

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RESEARCH AND PRODUCTION



PLATINUM METALS CATALYSIS

In many procedures, production control, purity of end product and cost of catalysis are brought to peak efficiency through the use of one of the Platinum Metals Catalysts.

If catalysis is part of your production or if you are developing a new process or product involving a catalytic stage, the platinum metals catalysts certainly warrant your investigation. A Baker research representative will be glad to assist.

Baker developed catalysts are helping to lower catalysis costs and provide many important production advantages for large and small-scale manufacture of industrial chemicals and pharmaceuticals. Here, the world's largest facilities for platinum metals catalyst research and production and our vast experience in this field, are at your service—in full confidence, of course. We'll be pleased to have you call or write.

THE PLATINUM METALS CATALYSTS ARE NOW USED FOR:

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DEHYDROGENATION
RINGCLOSURE • DOUBLE BONDS
NITRO GROUPS • ALDEHYDES
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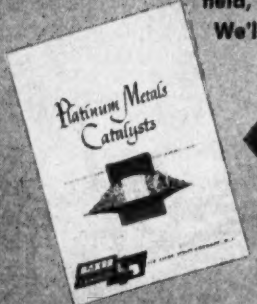
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PURIFICATION OF HYDROGEN, NITROGEN • PRODUCTION OF INERT ATMOSPHERES, REMOVAL OF OXYGEN, CARBON MONOXIDE FROM GASES

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SEND FOR NEW BOOKLET

PLATINUM METALS CATALYSTS, Notes on Their Uses and a list of their most available forms.

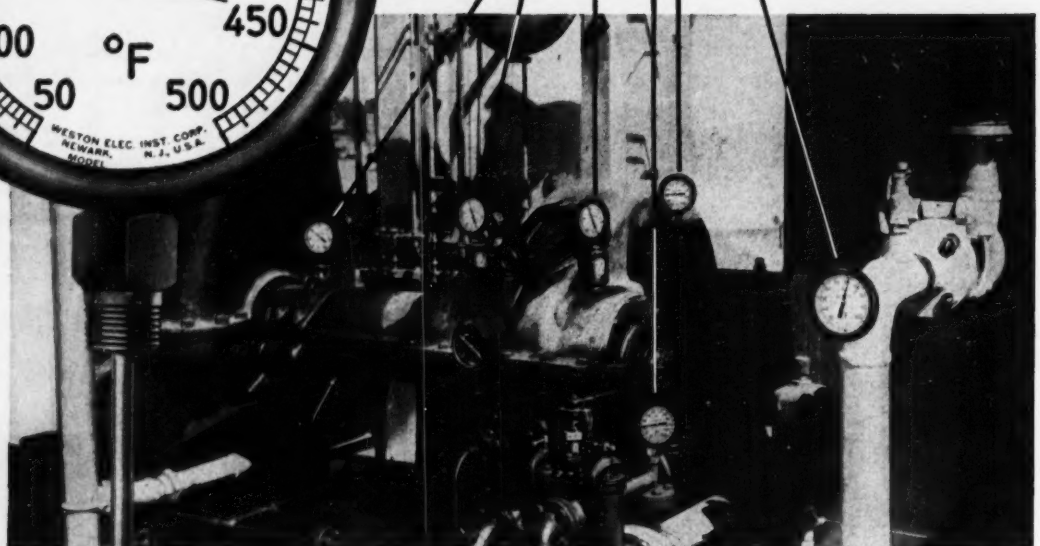
BAKER & COMPANY, INC. CATALYSTS

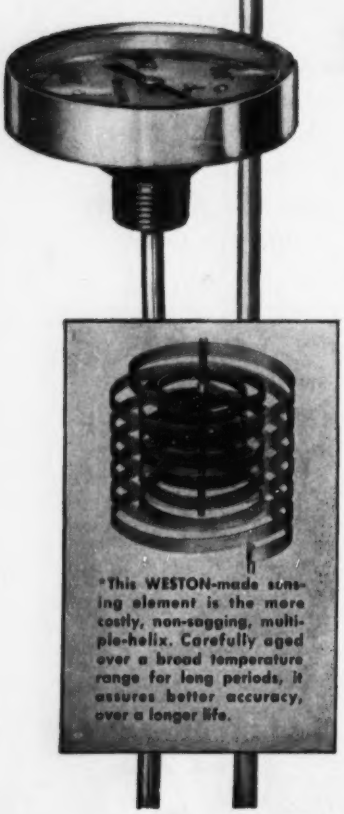
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THE HUB OF PLATINUM METALS RESEARCH



AT EVERY CHECKPOINT





WESTON *all-metal* THERMOMETERS

(with Multiple Helix)*

Here's another typical example of how large processing plants have solved temperature checking problems, and cut thermometer costs besides. With a WESTON dial-type thermometer at every checkpoint, temperatures are read at a glance . . . in far less time, and with far greater accuracy. Their sturdy all-metal construction resists breakage, gives them far longer life on operating equipment. And the exclusive WESTON multiple helix employed assures dependable accuracy during all this long life.

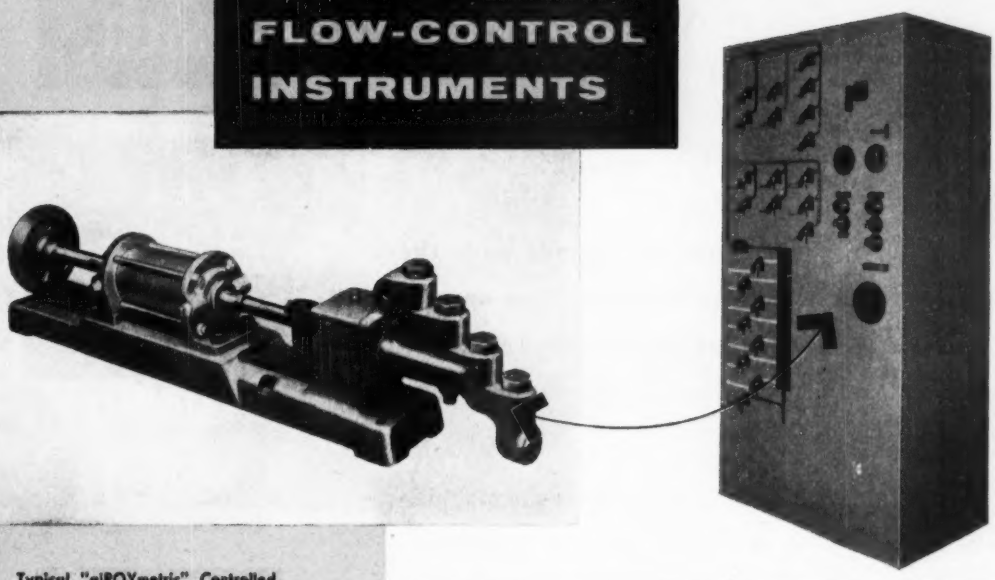
Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON 5537 *Thermometers*

Stocked by leading Distributors

CONTROLLED VOLUME PUMPS ARE FLOW-CONTROL INSTRUMENTS

This Milton Roy graphic panel provides centralized control and monitoring of 23 air-powered Controlled Volume Pumps to regulate a continuous polymerization process



Typical "aiROYmetric" Controlled Volume Pump. Air-powered pumps have a capacity range of from .04 to 405 gallons per hour against pressures up to 25,000 pounds per square inch. Capacity can be varied manually or automatically.

MILTON ROY GRAPHIC PANEL CONTROLS CONTINUOUS PROCESS

Flow controllers, ratio controllers and final control elements . . . these are the functions performed by 23 Controlled Volume Pumps in automatically controlling a continuous process.

This graphic panel—installed after full study and pilot plant testing—provides centralized control and monitoring of all 23 Controlled Volume Pumps used in the process. Some of these pumps control the flows and maintain the ratios of process streams. Others are used as final control elements, controlling the flow of catalyst in response to process demand, as dictated by the reactor temperature controller.

Milton Roy Controlled Volume Pumps are flow-control instruments that can *solve your flow-control problems*. Our Engineering Services include detailed recommendations on pumps, process instrumentation, accessories, panel design and construction.

Reference Literature: Write for Application Engineering Data Sheet A-54-2 "Instrumentation of a Continuous Reactor" and Bulletin 1053 "Air-Powered Controlled Volume Pumps."

See the MILTON ROY EXHIBIT
BOOTHS 131-136
First International Instrument Congress and Exposition
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These are the pumps with the enviable reputation for efficiency. They operate without attention, delivering trouble-free, cost-reducing performance on "'round-the-clock" schedules.

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Wilfley Model "AF" Pump with wetted parts of durable, corrosion-resistant plastics.



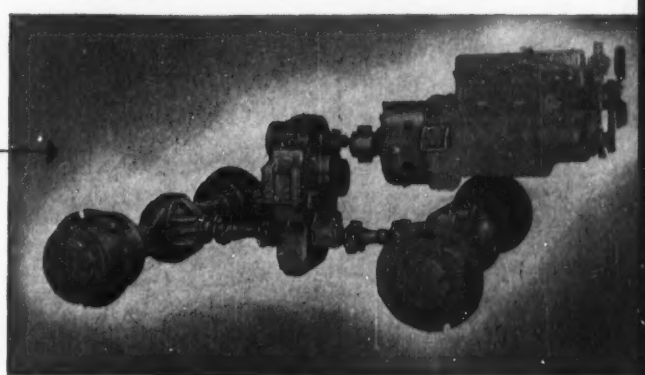
Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
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WILL DO MORE WORK FOR YOU!



* *This Power Train — from engine to tires — engineered and manufactured by Clark*



* **CLARK TORQUE CONVERTER** — 3-to-1 multiplication factor provides maximum torque *when it is needed.* Precise control in inching and digging.

* **CLARK POWER-SHIFT TRANSMISSION** —no conventional clutch; four speeds forward and reverse—direction control by lever on the steering column.

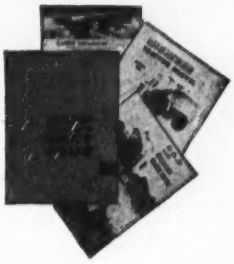
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RESULT — easier operation, utmost accessibility and simplicity of servicing, highest efficiency in shovel handling.

ADD greater weight and more horsepower than any front-end loaders of comparable capacity, and you see why you can Move More with a MICHIGAN*.

*A Trademark of Clark Equipment Company

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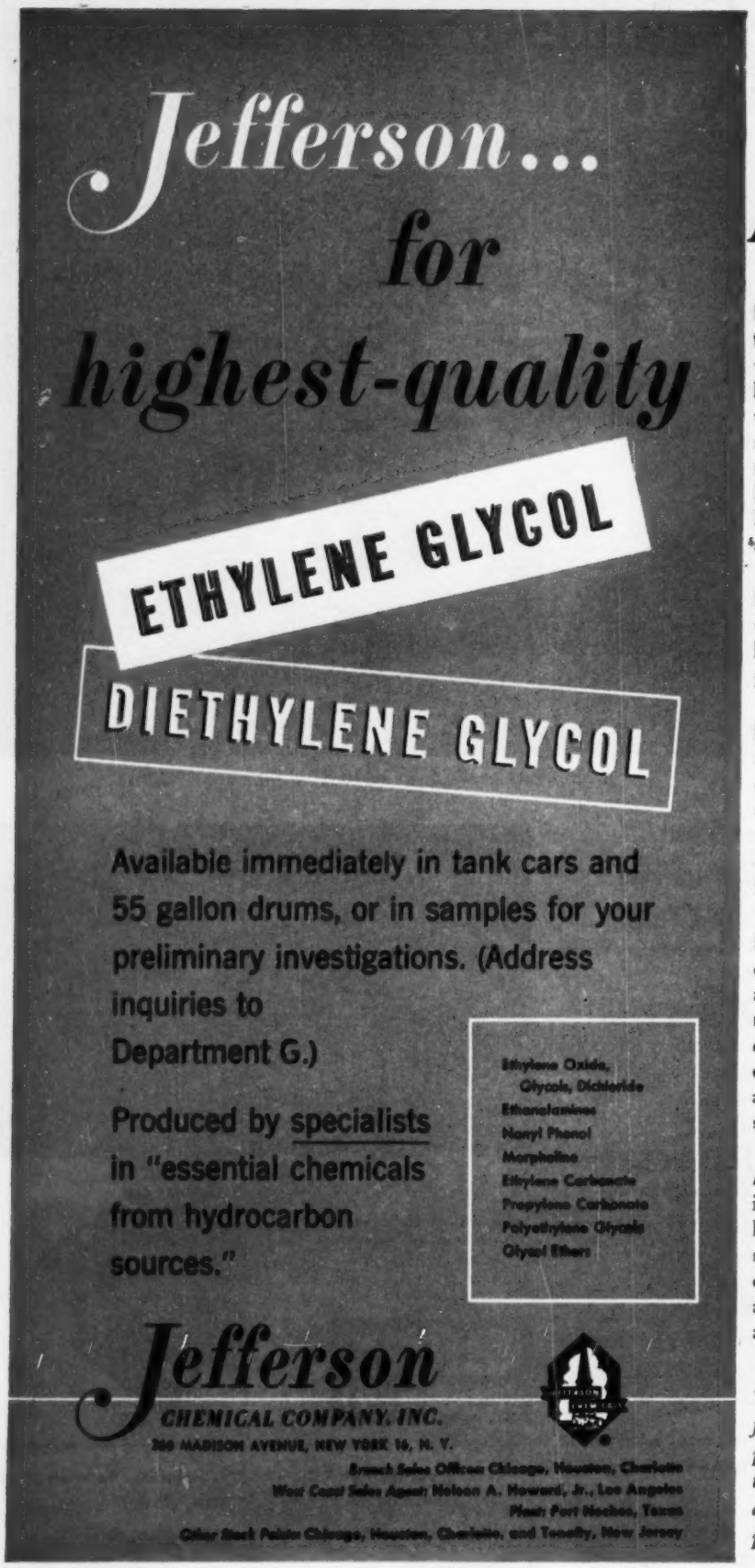
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Briefs

From recent literature

No. 6 in a Series

Lubricating grease compositions which are resistant to the solvent action of low boiling hydrocarbons are prepared by replacing the water of an inorganic hydrogel (e.g., silica gel) with ethylene glycol. After the ethylene glycol is added to the hydrogel, the gel is mixed in a steam-heated mill to evaporate the water and reduce particle size.

Sterilization of air to kill bacteria, viruses and molds is accomplished by introducing vapors of ethylene glycol into ventilation systems.

Paper coatings which are flexible and grease-proof are prepared from emulsions of plasticized polyvinyl acetates. These emulsions consist of a monoester of a glycol such as diethylene glycol, and an abietic acid having a terminal hydroxyl group.

Fiber-forming polyesters are produced by reacting ethylene glycol and a dicarboxylic acid. The reaction takes place at reduced pressures and elevated temperatures. These polyesters may be also used as softening agents, coatings, and film-forming substances.

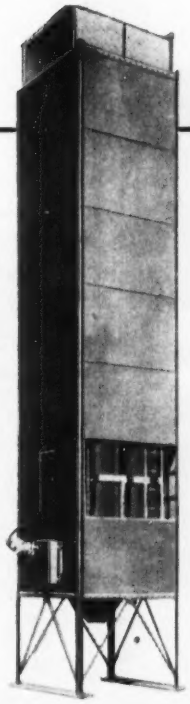
Abrasive suspensions for grinding or polishing various types of hard materials can be prepared by suspending small particles of silicon carbide, aluminum oxide or other abrasives in a medium consisting of a fatty acid ester of ethylene glycol.

These developments are abstracted from recent publications or U. S. patents. They may suggest applications of Jefferson Ethylene Glycol and Diethylene Glycol in your products or processes.

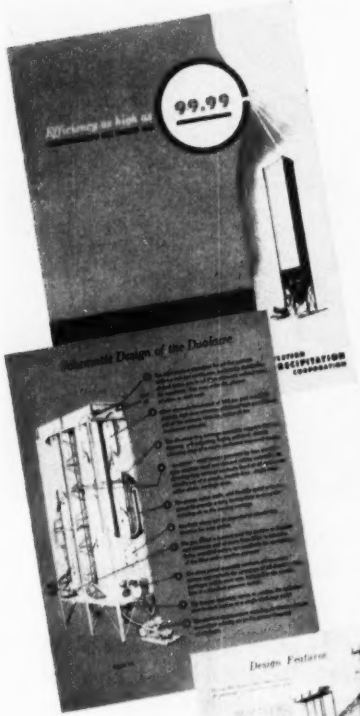
The latest advancement in dust recovery

Dualaire*

REVERSE-JET DUST COLLECTOR!



- *Cleans without jarring or rapping!*
- *Maintains uniformly low pressure drop!*
- *Field-proven efficiency as high as 99.99%!*



Backed by the same organization that pioneered commercial application of COTTRELL Precipitators and MULTICLONE Collectors, the DUALAIRE Reverse-Jet Dust Collector is revolutionizing filter-type recovery systems. The DUALAIRE gives you vital advantages like these . . .

REVERSE-JET CLEANING ACTION cleans the filter tube continuously in small increments—not with sudden surges as in rapping or jarring.

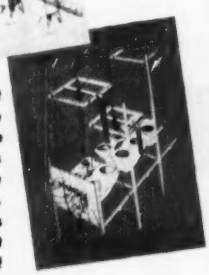
CLEANING ACTION starts automatically and stops automatically to keep pressure differential within low pre-set range.

FILTER EFFICIENCY remains uniformly high at all times because no thick filter cake ever forms to reduce effectiveness. Actual field tests show efficiencies as high as 99.99%!

NO STANDBY UNITS, with their complicated switching devices, are needed. The DUALAIRE is cleaned as it filters—without interruptions or shut down periods for cleaning. The operation is continuous!

FILTER UNITS LAST LONGER because they are not subjected to intermittent jarring, rapping or vibration—all destructive to filter fabrics.

The above are only a few of the many important advantages you get in DUALAIRE Dust Collectors. This 12 page booklet gives the full story . . . explains how reverse-jet cleaning action works — shows how the basic DUALAIRE unit is adaptable to a wide range of operating requirements — provides facts, figures and illustrations that will change your thinking on filter-type recovery systems. Send for your free copy of this descriptive booklet — or see your nearest Western Precipitation representative!

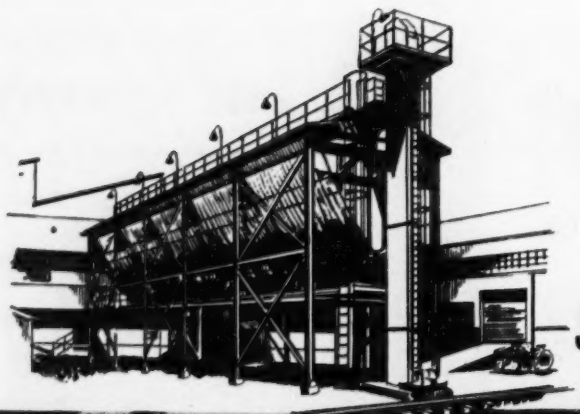


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VERSATILE...

is the word for JEFFREY standard units



Line drawing: Jeffrey Standard Bucket Elevator feeding storage bin.

Photo: Jeffrey Twin-Spiral Conveyor System handling finished cement from mill to railroad cars for bulk shipment.

OTHER JEFFREY STANDARD UNITS
BELT CONVEYORS
APRON CONVEYORS
SCRAPER CONVEYORS
POWER SCOOPS

Jeffrey Standard Spiral Conveyors and Bucket Elevators are available in a range of types and sizes that meet practically every industrial requirement and operating condition.

Each Spiral Conveyor is completely assembled in our plant to assure perfect fit and alignment. Before dismantling for shipment, parts are match-marked to facilitate field erection.

Split-head Sections are available on Jeffrey Standard Bucket Elevators. New High-Front Buckets on continuous types increase the versatility of the line.

WRITE FOR CATALOGS CONTAINING COMPLETE INFORMATION.

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

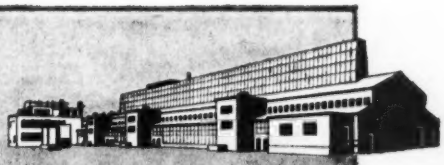
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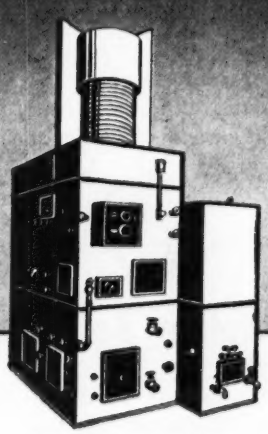
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. . .IT'S A JOB FOR JEFFREY!

5000° F



Silicon Carbide Plant





-340° F

Air Fractionation Plant

Blaw-Knox Chemical Plants Division has executed many successful projects involving temperature levels from

-340° to 5000°F

A few representative projects include: plants for producing silicon carbide and dry ice—for low temperature fractionation to yield oxygen, nitrogen, argon, hydrogen and ethane . . . heat transfer systems using Dowtherm, Aroclors and liquid metals . . . equipment such as the radiant fired kettle.

Blaw-Knox engineers and scientists will design and build your project operating at any temperature level within a wide range.

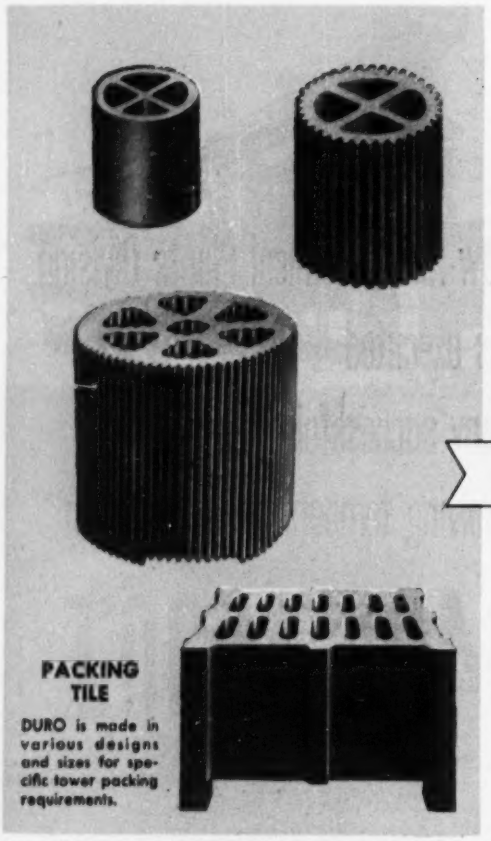
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CHEMICAL PLANTS DIVISION

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PACKING TILE

DURO is made in various designs and sizes for specific tower packing requirements.



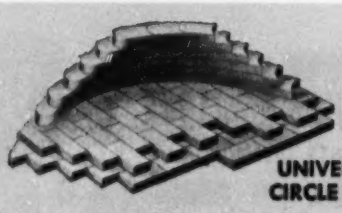
FLOOR TILE

Various sizes of DURO tile and cove base shapes are furnished for acid-proof floor construction. They serve well for use under hard wearing conditions. In many applications they are used where exposed to hot chemicals and drosses.



BOOK TILE

DURO Book Tile are machine-made in different sizes and provide the flexibility of fitting many diameters.



UNIVERSAL CIRCLE BRICK

The unique design of Universal Circle Brick is especially advantageous for use in cylindrical tanks and towers, because one size will fit different diameters.

Harbison-Walker

DURO

ACID-PROOF BRICK AND SHAPES

Refractories

- DENSE AND VITREOUS
- STRONG AND ABRASION-RESISTANT
- HIGHLY IMPERMEABLE TO GASES AND LIQUIDS
- RESISTANT TO CORROSIVE CHEMICALS
- REFRACTORINESS ADEQUATE FOR TEMPERATURES UP TO 2300°F. WITH ACID FUMES

The unusual combination of high refractoriness and high acid resistance of DURO account for its extensive use for a wide range of chemical processing applications.

The excellent properties of DURO are attributable to the low flux content of the material with which it is made and to the manufacturing procedures. The high temperature at which it is fired converts its composition to minerals which are highly insoluble in acids and other corrosive chemical solutions.

DURO is available in all the usual standard sizes and is made in a wide variety of special shapes.

Harbison-Walker Refractories Co.

AND SUBSIDIARIES

WORLD'S LARGEST PRODUCER OF REFRACTORIES

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ALL OVER THE PLANT... YOUR PLANT!

ROCKWELL Industrial Meters

WILL SAVE MONEY, MAKE MONEY FOR YOU!



Wherever valuable liquids are stored, mixed or consumed, you will be way ahead to measure them with Rockwell industrial meters. They provide *accurate* records to verify your purchases, to stop losses. They guard the quality of your formulations when blending, mixing, batching. Your accountants will welcome meter records for cost control and tax analysis purposes. These same records will enable you to keep tab on all liquid inventories.

There is a size and type of Rockwell meter to measure most any liquid that can be piped—oils, chemicals, paints, liquors, solvents, etc.—even corrosive fluids. Automatic shut-off valves and remote registration systems are available. For full facts use the handy coupon or write for bulletins.



Rotocycle meter, cut away to show the all-revolving rotor construction.

NOW

A STAINLESS STEEL METER

FOR MEASURING CORROSIVE LIQUIDS

This Rockwell Model 2-BC meter is constructed *inside and out* of stainless steel. It resists corrosion. Rated capacity 100 gpm. This is an ideal meter for measuring liquids entering into foods and pharmaceuticals—also chemicals and corrosive liquors. Write for bulletin OG-403.

YOU CAN RELY ON ROCKWELL

CLIP COUPON—MAIL TODAY

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ROCKWELL MANUFACTURING COMPANY
Pittsburgh 8, Pennsylvania

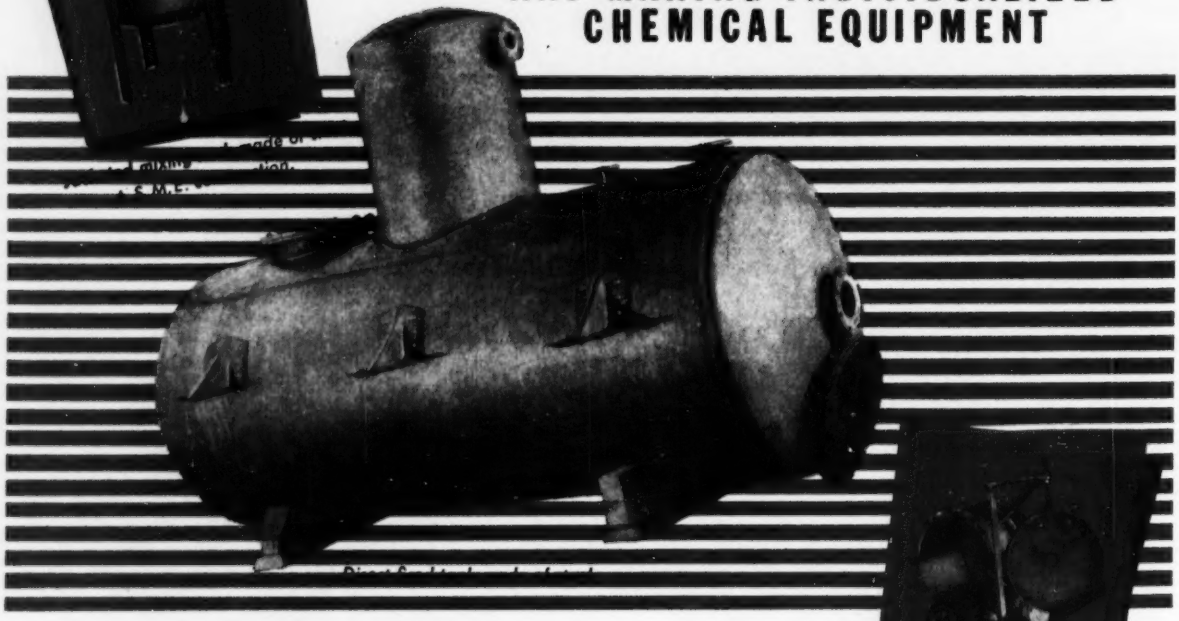
Gentlemen:
I am interested in measuring _____
(Name of Liquid)
Pipe Size _____"
Working Pressure _____ psi. Temperature _____ °F max.
Max. Flow Rate _____ gpm. Min. Flow Rate _____ gpm.
YOUR NAME _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____



WHEN ROBERT E. PEARY
STARTED HIS FIRST
POLAR EXPEDITION

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WAS MAKING INDIVIDUALIZED
CHEMICAL EQUIPMENT



Many adventurous men have challenged the frozen wastes of the north—yet even in Peary's day, KOVEN was already helping chemical manufacturers increase output and cut costs with individualized equipment. Over the years, more and more leading chemical plants have turned to KOVEN because experience has shown—KOVEN units, tailored to their exact needs, mean faster, more profitable production. If you have a production problem, one of our trained representatives will be glad to discuss it with you—of course, there is no obligation. Send for Catalogs #550 and #501.

Complete modern facilities including X-ray inspection and stress relieving which insure quality control. KOVEN equipment in all commercial metals and alloys include: Pressure vessels, extractors, mixers, stills, condensers, kettles, tanks, chutes, containers, stacks, breechings, coils. Fabrication to A.S.M.E. Code Par. U-68 and U-69 a specialty.

Horizontal rotary mixer.







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KOVEN FOR INDIVIDUALIZED EQUIPMENT SINCE 1881

Another new development using

B. F. Goodrich Chemical *raw materials*



Filter unit contains filters, fittings and inside rings made from rigid Geon. Operator pictured holding an inside ring.

B. F. Goodrich Chemical Company does not make this filter. We supply only the High-Impact Geon resin.

RIGID PLASTIC FILTER COSTS NO MORE..GIVES 6 TIMES MORE WEAR

INDUSTRIAL acid filters made of Geon rigid vinyl plastic are setting new records in cutting costs of nickel plating bath operations. Where stainless steel filters lasted only 3 weeks to 3 months in corrosive nickel plating solutions, these vinyl plastic filters have been on the job for nearly 18 months—with no signs of wear! The cost of the vinyl filter runs about the same as a stainless steel one, but the 6-times longer wear means huge replacement cost savings.

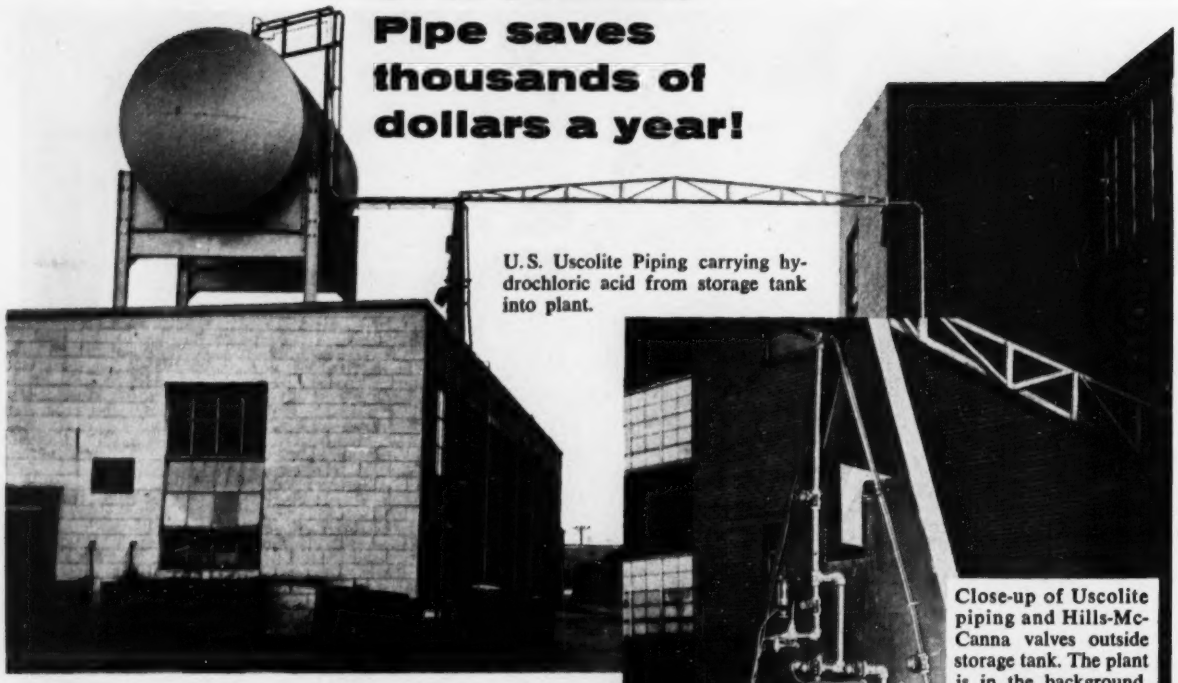
The exceptional resistance of Geon rigid vinyl to the highly corrosive nickel plating solution, maintained at a temperature of 120°F., points up only one advantage of this basic material. For instance, products made from Geon rigid vinyl can be machined, welded, sawed or drilled. They also resist abrasion, many acids and chemicals.

Geon polyvinyl materials have a wide range of uses in the chemical industry—from rigid filters, tubing, and sheeting to tank and drum linings. We'll help you select the Geon material best suited to your needs. For information, please write Dpt. GE-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable
GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

New acid-handling system incorporating U. S. Uscolite Pipe saves thousands of dollars a year!



U.S. Uscolite Piping carrying hydrochloric acid from storage tank into plant.

Close-up of Uscolite piping and Hills-McCanna valves outside storage tank. The plant is in the background.

A large Eastern manufacturer of lighting and signaling systems uses 300 feet of Uscolite® plastic pipe to carry hydrochloric acid from storage tanks outside the plant across an areaway, and then through various production departments to final use in the plating room. Previously, carboys of acid had been used, because the plant had no facilities to store acid in bulk. But by installing a new acid-handling system, using U.S. Uscolite piping and fittings, the plant saves thousands of dollars a year—they now *buy and store in bulk*. Additional thousands are saved by reduced handling costs.

The plant also fabricated its own fume hoods from Uscolite sheet stock, for use in the plating operation. The plant engineer is pleased because Uscolite's unusual mechanical strength enables it to be left exposed in any weather, and to be run overhead through various parts of the plant without fear of damage to men or machines. Hills-McCanna Uscolite valves are used in the piping assembly.



Uscolite pipe and fittings are made in the broadest and largest line of stock sizes on the market.

Made by United States Rubber Company, Uscolite is light in weight with high impact strength. It is solving acid and corrosion problems in every industry. The piping can be easily threaded and installed with conventional tools. For replacements or a completely new piping system, get in touch with any of our selected distributors, or any of our 27 District Sales Offices, or write to address below.

"U.S." Research perfects it..."U.S." Production builds it...U.S. Industry depends on it.

UNITED STATES RUBBER COMPANY

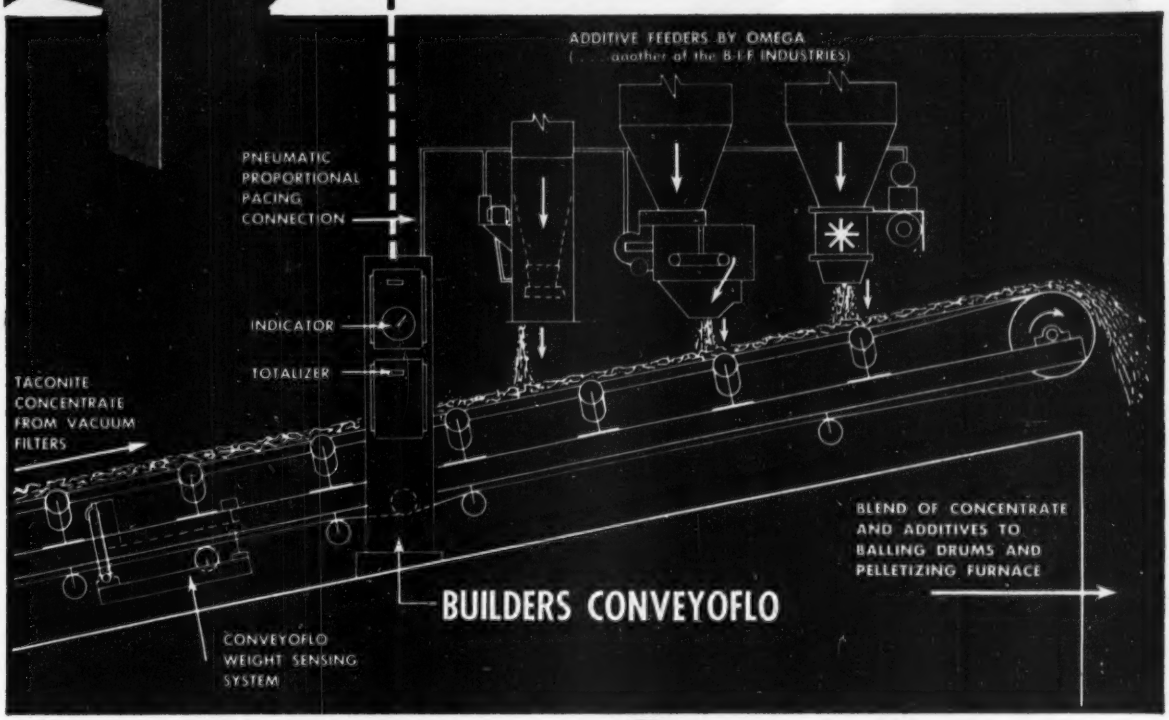
MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

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AUTOMATION TAKES OVER TACONITE PROCESSING

WITH . . . **BUILDERS CONVEYOFLO**

To handle the millions of tons of ore processed in the modern taconite plant requires the latest in high-speed, high-accuracy processing equipment. See in this flow diagram how Conveyoflo's pneumatic weight sensing system is ready-built to pace auxiliary additive feeders to produce the proper blend for the pelletizing process. Then see for yourself how Conveyoflo can help simplify and systematize your continuous processing operations. We welcome your inquiry.



CONVEYOFLO FEATURES

- **ACCURATE** . . . within ± ½ of 1% of actual weight from maximum to 50% of rated capacity; within 1% from 50% to 25% rate; within 2% from 25% to 10% of meter's rated capacity.
- **COMPACT** . . . weight sensing mechanism completely contained within conveyor structure. No overhead levers. Panel stand only 9" x 18" — may be any height.
- **AUTOMATIC TOTALIZER COMPENSATION** for variations in belt speed and changes in belt weight.
- **RESPONDS ACCURATELY** to rapid load variations.
- **PACES AUXILIARY EQUIPMENT** (feeders, controllers, continuous blending processes, etc.) and operates secondary totalizers, indicators, recorders.

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DIVISION OF B-I-F INDUSTRIES, INC.
METERS FEEDERS CONTROLS

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369 Harris Ave., Providence 1, R. I.

Please send Bulletin 350-H4A describing Builders Conveyoflo Meter.

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City..... State.....

You'll save time and trouble on H.P. VESSEL GASKETS





...when J-M Goetze gasket specialists make them for you

When you need gaskets such as those above, which were made for pressure vessel service over 5000 psi, consider this. It takes less time and trouble to turn the job over to J-M Goetze —an organization that has specialized in gasket design and manufacture for 67 years. And it usually costs less in the long run.

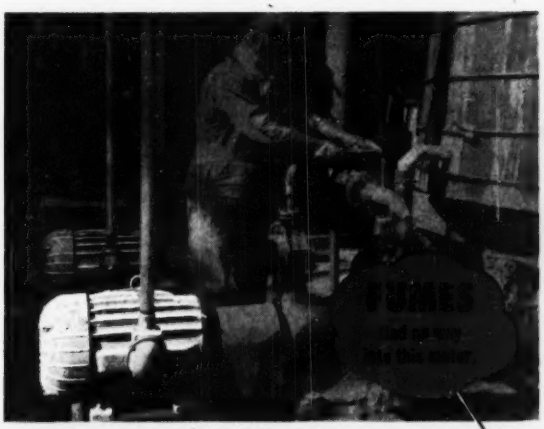
Goetze engineers can select the right style for maximum sealing efficiency. They know the correct metals and other factors required for efficient, long-lasting gaskets.

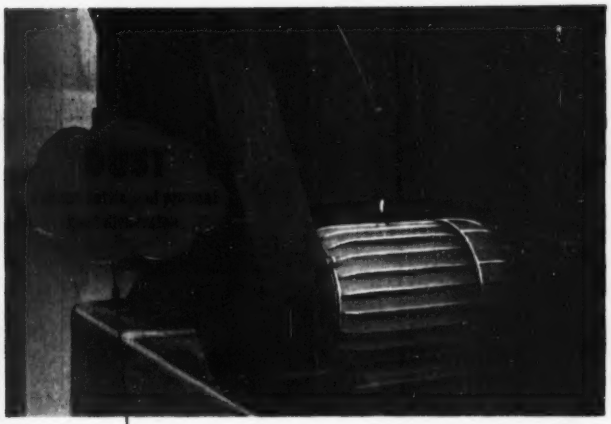
Goetze Gaskets are made exactly to the last detail of your specifications and conditions. They are made to craftsmen's perfection . . . with modern machine tools, some of which were specially designed by Goetze for gasket manufacture.

If you need gaskets for high pressure vessels or similar applications, send us a drawing or template for quotation. Or write for further information to Johns-Manville, Box 60, New York 16, New York.

Johns-Manville *Goetze* GASKETS

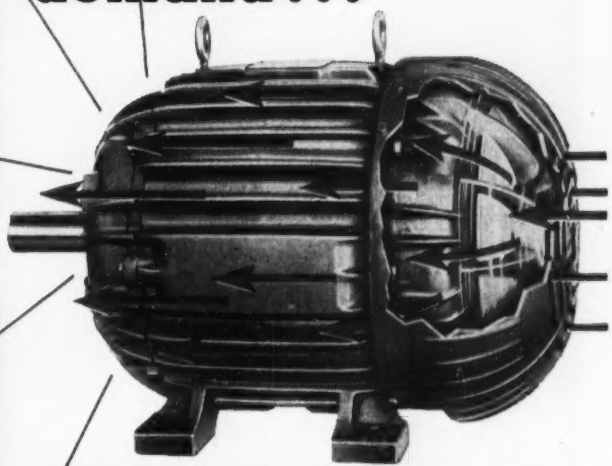
THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

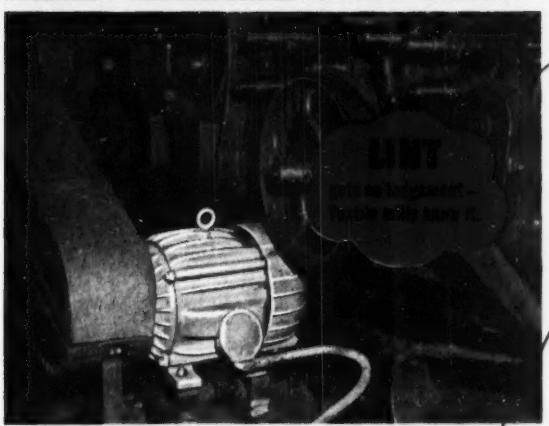


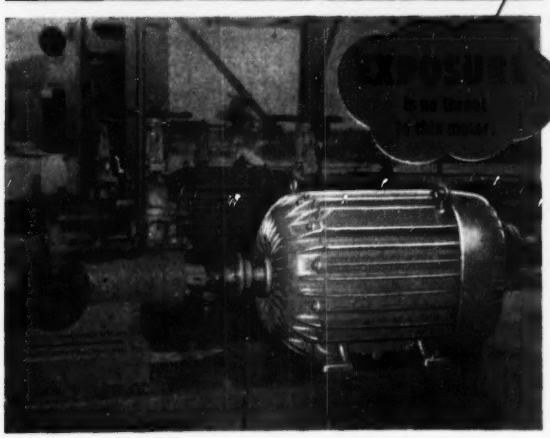




Tough conditions demand . . .







ELLIOTT C-W *Sealedpower* MOTORS

The ribbed frame provides effective heat radiation . . . The fan-driven cowl-directed air-blast carries off the heat, and also prevents the settling of dust on the motor frame, which would tend to reduce heat dispersion . . . The streamlined fan has no corners to collect dirt . . . Cowl can be quickly removed if or when necessary. Here is a TEFC motor you can put anywhere. Wide range of modifications for specific needs. Sizes 1 to 100 hp, NEMA frames. Ask your local Elliott representative for full data, or write for bulletin to Elliott Company, Crocker-Wheeler Division, Ampere, N. J.

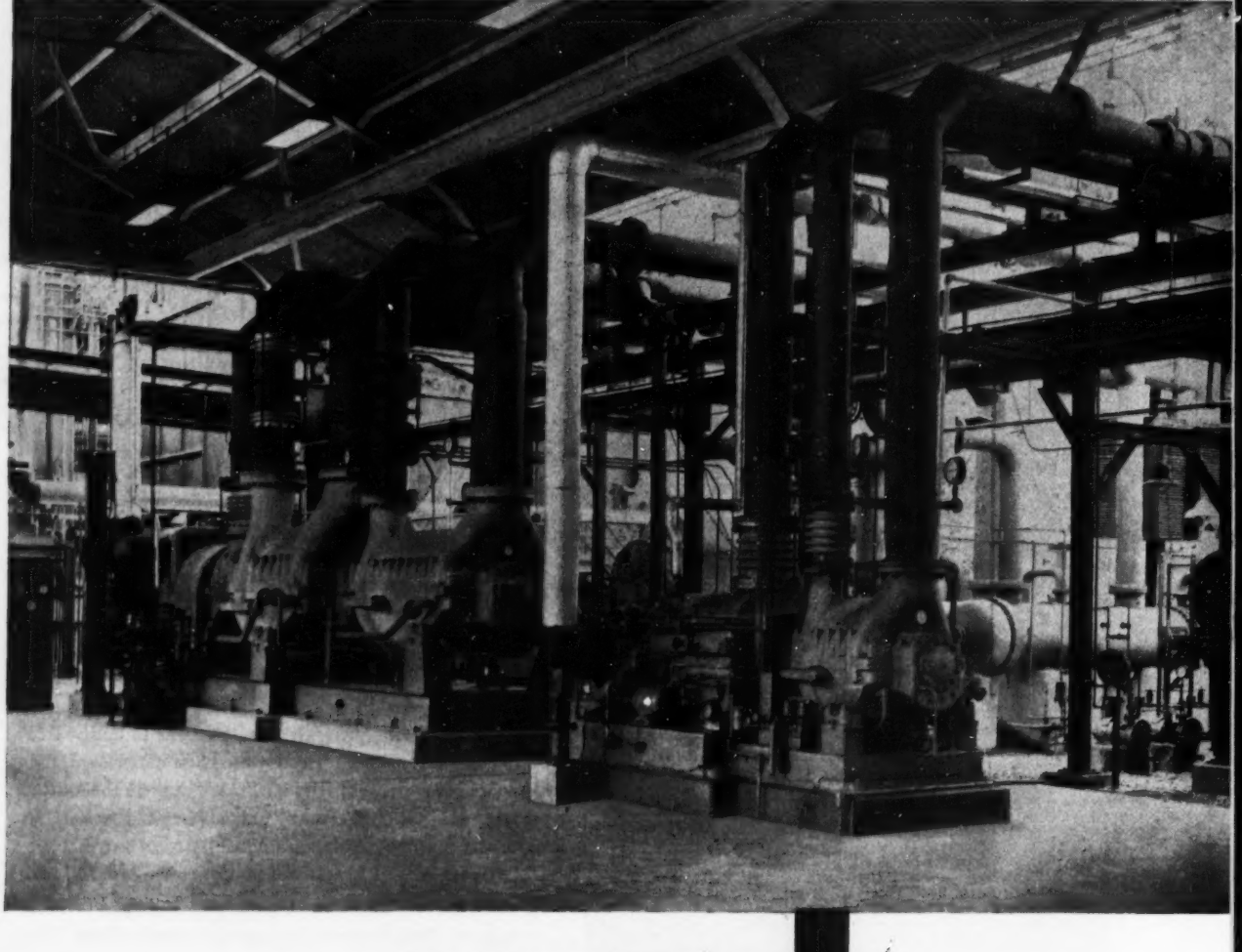
ELLIOTT Company

W4-1

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS

CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

Three newest partial oxidation plants in the U.S. use centrifugal air compressors



On the left a 5000 BHP steam turbine drives a five-stage No. 4 Compressor and an eight-stage No. 3 Clark Multi-Stage Centrifugal Compressor. Rated at 20,000 CFM, air is pumped to 125 PSIG. The other unit is a Clark four-stage No. 2 Centrifugal Compressor rated at 650 BHP compressing nitrogen.

all 3 select Clark Centrifugals

When Spencer Chemical Company's new Vicksburg, Miss. ammonia plant recently went on stream, it became the first of three new plants which will use centrifugal air compressors in the partial oxidation method of making hydrogen. Significantly, all of the plants have selected Clark Multi-Stage Centrifugal Compressors.

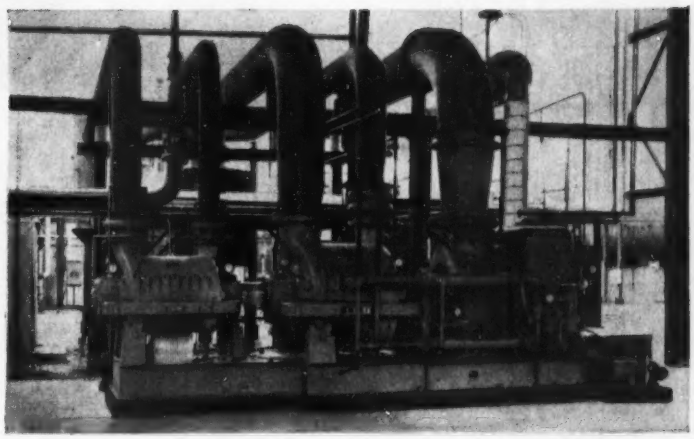
The new Spencer Chemical plant, which manufactures ammonia, nitric acid, ammonium nitrate and ammoniating solutions, is outstanding for its compactness and high degree of process integration.

The continued preference for Clark Centrifugals to serve varied process applications is the natural result of many points of superiority which your nearest Clark representative will be glad to detail for you.

CLARK BROS. CO. • OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

Sales Offices in Principal Cities Throughout the World



A 3800 BHP turbine driving a five-stage No. 3 and an eight-stage No. 2 Clark Centrifugal Compressor. Capacity of this unit is 15,000 CFM with a discharge pressure of 125 PSIG.

5 outstanding Clark Centrifugal features

STANDARDIZATION
Simplifies installation, operation and maintenance. Units readily adaptable to existing pipe arrangements and future plant expansion.

SEALING
Clark leads the field in the number of available types and the development of new seals for specialized uses.

RUGGEDNESS
Unitized design. Bearing chambers cast integral with case. Accurate alignment maintained at high speeds and pressures.

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Clark experience in handling so many different and difficult applications saves you money and speeds your delivery by eliminating the need for performance testing. Only a mechanical test is required. Clark knows the performance of its machines.

COOLING
Enables accurate control of process temperatures. Cooling and compression duties separated. Reduction in horsepower. One unit often can do the work of two.

CLARK

compressors

Clark sets the pace in compressor progress

3-way answer

to steam trap problems

• This three-way combination can help lick your steam trap problems.

YARWAY IMPULSE STEAM TRAP . . .
the steam trap that gets equipment *hot in a hurry and keeps it hot.* Small size, light weight, *body and all working parts of stainless steel.* Low cost, low maintenance.

YARWAY FINE SCREEN STRAINER . . .
with high-grade woven Monel wire screen that is removed with the cap for easy cleaning. Rust-proof finish . . . straight threads, machined faces and spark-plug type gaskets on screen caps.

YARWAY ENGINEERING SERVICE . . .
32 trained YARWAY engineers working out of YARWAY branch offices from coast-to-coast, are constantly helping on *trap selection, installation maintenance* and *operation.* Solving your trap problems is their job. It will cost you nothing to call them in to assist you.

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.

• YARWAY IMPULSE STEAM TRAPS AND STRAINERS are immediately available from more than 250 Industrial Distributors in the United States, Canada, and other countries. For name of one nearest you and FREE Steam Trap Bulletin write . . .





YARWAY Fine Screen Strainers. "Police the pipelines" in thousands of plants.





impulse steam traps

And Yarway Fine Screen Strainers

WHERE HAVEG CYLINDRICAL TANKS ARE INSTALLED

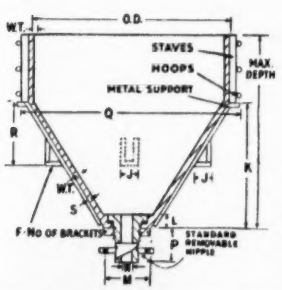
TRADE MARK REG. U. S. PAT. OFF.

STORAGE TANKS • PRESSURE TANKS • REACTION VESSELS • VACUUM AND SAND FILTERS
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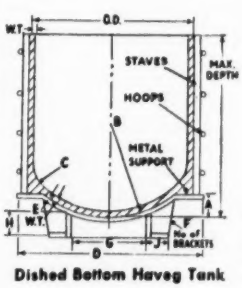
From **TOPS** . . . where tanks are vented to the atmosphere, four types of covers may be obtained. Haveg can be machined and repaired readily so that connections, manholes and changes to the system present no problem to the installation and maintenance crew.

To **SIDES** . . . remember that Haveg is not a tank lining or coating. It is a solid, non-metallic material fabricated to the desired size and thickness. It can be molded in one seamless piece as large as 10 feet in diameter by 12 feet in depth. Haveg comes in three grades for outstanding resistance to corrosion—Haveg 41 for acids, salts and solvents; Haveg 60 for alkalies, solvents, acids and salts; Haveg 453 for fluorine compounds.

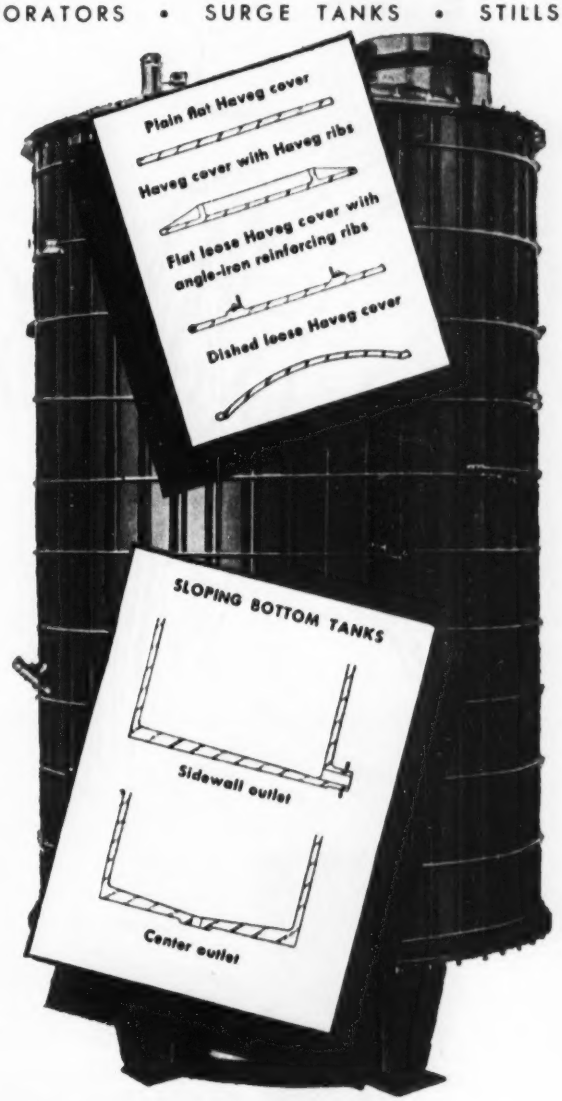
To **BOTTOMS** . . . get the best bottom for the process with molded Haveg. Sloping bottom tanks can be provided with outlets at any location. For more complete drainage, dished bottom tanks are available and when suspended solids are present, cone bottom tanks can be provided.



Cone Bottom Tank for applications requiring complete drainage.



Dished Bottom Haveg Tank



Chemical Corrosion has been Controlled!

Yes, Haveg is a superior material for tank construction. Made from acid digested asbestos bonded with special corrosion-resistant resins, Haveg is usually molded and cured into its finished form—tanks, towers, pipes and fittings, valves and pumps, fume duct systems, heat exchangers. It comes in the size you need and is delivered fast!

Haveg withstands rapid temperature changes and enables you to go into a high range of process temperatures with complete safety and a proven history of reliable performance. Whatever the service, Haveg lasts and lasts and lasts. It gives resistance to corrosion through and through, never allowing corrosives an opening wedge from cracks.

Get all the facts about Haveg. Call the sales engineer listed, consult Chemical Engineering Catalog, write for big 64-page Bulletin F-6 today.

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PERMUTIT Q

High capacity sulfonated styrene cation exchanger. Extremely resistant to wide pH ranges, high temperatures, oxidizing agents. Operates on Sodium or Hydrogen cycle.

Uses: Demineralizing water for better electroplating, better porcelain, better plastics and textile fibers; purifying polyhydric alcohols; sugar purification; metal and organic base recovery; separating rare earths.

PERMUTIT S

Quaternary amine, anion exchanger. Effective even at high pH values. Removes anions of WEAK acids as well as STRONG mineral acids.

Uses: Removes silica from water to as low as 0.01 ppm—at low cost; recovers chromates from plating and anodizing wastes; splits neutral salts.



OTHER PERMUTIT EXCHANGERS

CATION EXCHANGERS: Zeo-Karb®, Zeo-Dur®, Decalso® • ANION EXCHANGERS: De-Acidite®, Permutit A



RESPONSIBILITY...

Only Permutit provides both Ion Exchangers and Equipment

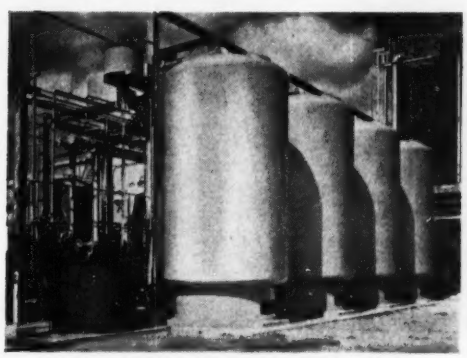
Field performance can be disappointing if based solely on lab-tube resin tests. Permutit knows this well.

For only Permutit furnishes its own wholly integrated ion exchange plants—the world's most complete line of resins, equipment, controls. This means that only Permutit can take undivided responsibility for the *complete performance* of the full-scale installation.

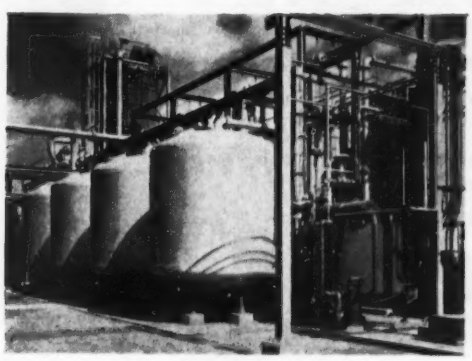
Best results are assured by Permutit's knowledge of *actual field performance* of the ion exchange resins we produce. This enables us to continually improve the resins we provide... to add properties which our laboratory, pilot plant and field experience prove most desirable.

Our sales engineers are backed by over 40 years of ion exchange research and experience. They will help you to evaluate lab-tube results, save you time and money in specifying the ion exchange resins and equipment most efficient for your problem.

To improve a process or product, call in Permutit. For specific applications data and resin samples, write to The Permutit Company, Dept. CE-10, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.



Automatic Permutit cation exchange equipment demineralizes 96,000 gph of process water and boiler makeup for a large refinery.



Automatic anion exchange units complete this Permutit installation. Effluent has lower total solids than distilled water! Costs much less!

Ion Exchange Headquarters for Over 40 Years

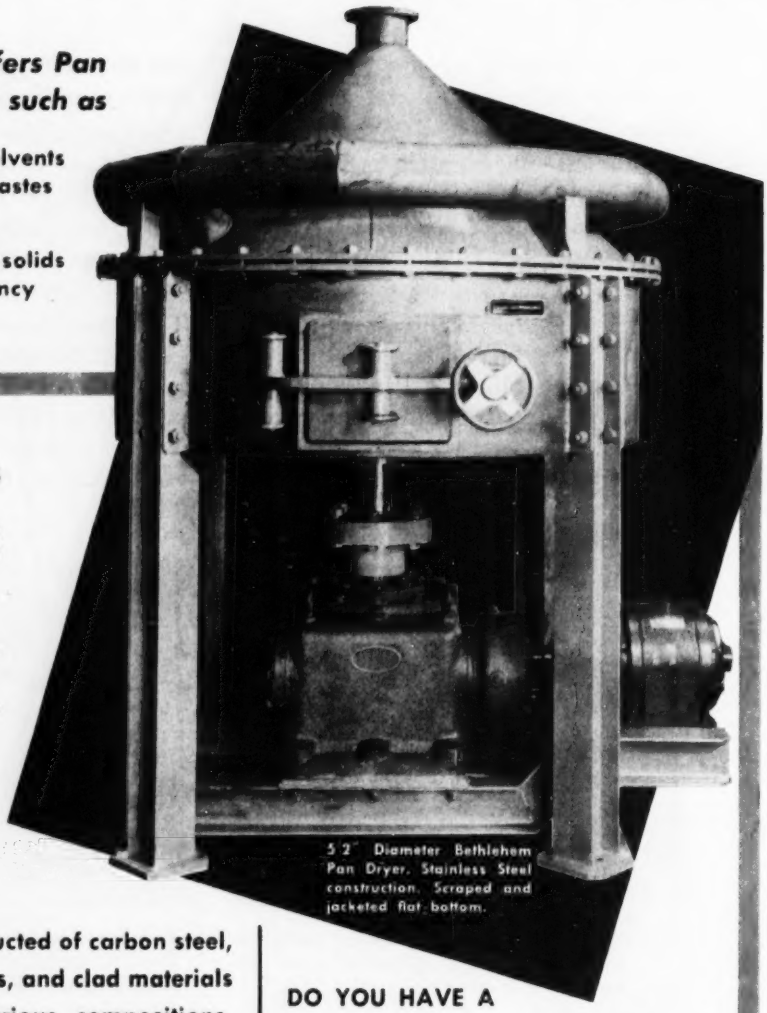
PERMUTIT®

For Solids Processing...

BETHLEHEM PAN DRYERS!

Bethlehem offers Pan Dryers for Solids processing such as

- evaporation of water and solvents from slurries, sludges and pastes
- drying of solids
- reaction between gases and solids or materials of high consistency
- sublimation



5'2" Diameter Bethlehem Pan Dryer. Stainless Steel construction. Scraped and jacketed flat bottom.

SPECIAL FEATURES OF BETHLEHEM PAN DRYERS

- large, flat bottom area for scraping solid material to provide good heat transfer
- scraping at wall
- plowing action for exposure and renewal of reactant surface
- intense agitation to break up and shear material
- quick-opening discharge door
- self-discharging action of agitator
- agitator blades selected to resist abrasion and wear

PAN DRYERS can be constructed of carbon steel, stainless steel and other alloys, and clad materials as well as cast iron of various compositions. Special care is taken to provide contamination free products for food and pharmaceutical processing, dye and organic intermediate purification.

DO YOU HAVE A

Solids Processing Problem?

Our engineers will be glad to discuss it.

WRITE TO

BETHLEHEM FOUNDRY & MACHINE CO.

BETHLEHEM — CHEMICAL PROCESS DIVISION — PENNSYLVANIA

so an Ostrich can take it . . .



. . . maybe your processing equipment is a little less hardy than the proverbially tough digestive mechanism of this odd bird.

Bits of iron—nails, wire, crushed tin, nuts and bolts—are a headache, sometimes a serious hazard, to a lot of food, chemical, and other processors. Many have successfully relied on Dings Magnets to solve their problem.

Dings makes a complete line of electric and non-electric magnets for installation in, on or above material conveying systems and integration with processing machinery. They can save you plenty of trouble. Learn about them by just mailing the coupon below.



Here's Just One Way — Dings Magnetic Pulleys — both electro and Alnico permanent — are at work in all kinds of industries pulling unwanted iron out of everything from grain and cotton to coal and molybdenum ore.

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Please send me a copy of Catalog C-5000-B

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TRENTWELD
tubing gives...

**corrosion resistance*

**long service life*

**ease of cleaning*

**product protection*

in Lo-Temp Evaporator

This Mojonnier Lo-Temp Evaporator is designed to remove water from heat-sensitive liquid foods, pharmaceuticals and chemicals, at temperatures as low as 40F. Heart of the evaporator is made of nests of TRENTWELD stainless steel tubing.

TRENTWELD tubing is an ideal choice for this application. For TRENTWELD stainless tubing resists the corrosive attack of both the product itself, and the ammonia refrigerant pumped inside the tubing. And TRENTWELD stainless is inert . . . protects the product from contamination. But that's not all—TRENTWELD comes-clean with an absolute minimum of effort.



So when you have a tubing application check first with TRENT. You'll find the largest assortment of sizes and finishes in the industry . . . standard sizes from $\frac{1}{8}$" to 40" O.D. — larger sizes on special order. And remember, TRENTWELD stainless and high alloy tubing are products of *tube mill specialists*. You can't buy better than TRENTWELD.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

In Two Years' Rugged Duty

"Never Down for Maintenance"



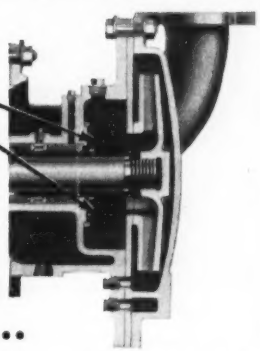
A-C Pump runs 4 times longer than previous unit ... *and still going strong*

A LARGE EASTERN CHEMICAL COMPANY is using Allis-Chalmers 4 x 3 PDE process pumps with *Equiseal* stuffing boxes to handle phosphoric acid water containing abrasives. These pumps operate 24 hours a day, 7 days a week. The unit shown above has been in use for approximately two years and *has never been shut down for maintenance.* The pumps previously used had to be completely reworked every six months and re-packed every three weeks. Naturally, maintenance costs have been drastically reduced.

Allis-Chalmers process pumps are available with or without *Equiseal* stuffing box, in a wide choice of materials to handle many types of abrasive or corrosive material at temperatures to 250° F. Every pump is individually engineered to each application. For details, contact your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 52B6615.

A-4395

Equiseal is an Allis-Chalmers trademark.

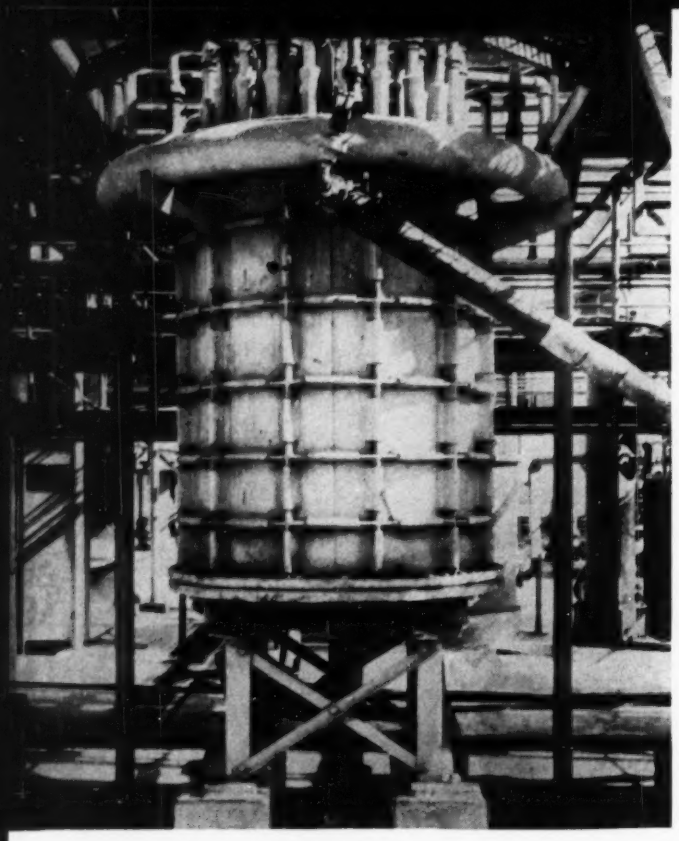


* *Why* this A-C feature prevents leakage...

Many A-C process pumps have the *Equiseal* stuffing box. This is an auxiliary impeller which produces a low pressure area in front of the packing. This low pressure area prevents the liquid being pumped from entering the packing (on suction heads to 15 feet at 1,750 rpm). Equipped with an *Equiseal* stuffing box, an A-C pump will actually run without packing.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS



Continuous Chlorination Is Key To BHC Process

But there's more to this Stauffer plant than just chlorination. Isomers are separated; the product concentrated.

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

Batch or continuous chlorination? This was one of the big questions facing Stauffer engineers during the design phase of the Henderson, Nev., 24% BHC plant.

After weighing the advantages and disadvantages of both systems—the batch operation produces higher yields—the decision went to continuous chlorination.

Another problem that had to be worked out involves the removal of isomers. Only the gamma BHC isomer has practical insecticidal value.

The operations of the completed Stauffer plant—including continuous chlorination; crystallization; and steam distillation—are shown on the flowsheet.

▶ **Chlorination**—Benzene (fresh make-up plus recycle benzene) and chlorine feed (from Stauffer's adjacent liquid chlorine department) are metered into one of two chlorinators in a continuous stream. The addition chlorination of benzene is essentially a chain reaction activated by actinic light. Peroxide catalysts are not used—they have a beneficial effect on the rate of reaction, but are too expensive for the incremental increase in yield they produce, and contaminate the finished product if not handled carefully.

The chlorinator operates at about atmospheric pressure, with a one pound pressure drop. Reaction temperatures are 40-60 C. Higher temperatures and pressures favor formation of an undesirable amount of monochlorobenzene.

Hourly checks are made on the specific gravity of the chlorinator product (13-14.5% γ BHC) to get an indication of total BHC concentration. If the total BHC concentration gets too high, the less soluble α isomer precipitates in the chlorinator.

▶ **Continuous vs Batch Chlorination**—Last chlorine increments are added at an increasingly low, uneconomical rate. And here is a big difference between batch and continuous chlorination—when operating several batch reactors in semi-continuous fashion, it's economical to let the addition proceed as far as possible. This cannot be done in a continuous system.

▶ **Benzene Recovery**—Chlorinator product is evaporated at 85-88 C. A large amount of benzene is recovered, condensed, scrubbed and returned to the chlorinator.

Liquid product remaining after evaporation goes to three crystallizers. Less soluble α and β isomers precipitate out at 35-40 C. Two trunnioned filters—each capable of holding a full crystallizer load—service the crystallizers.

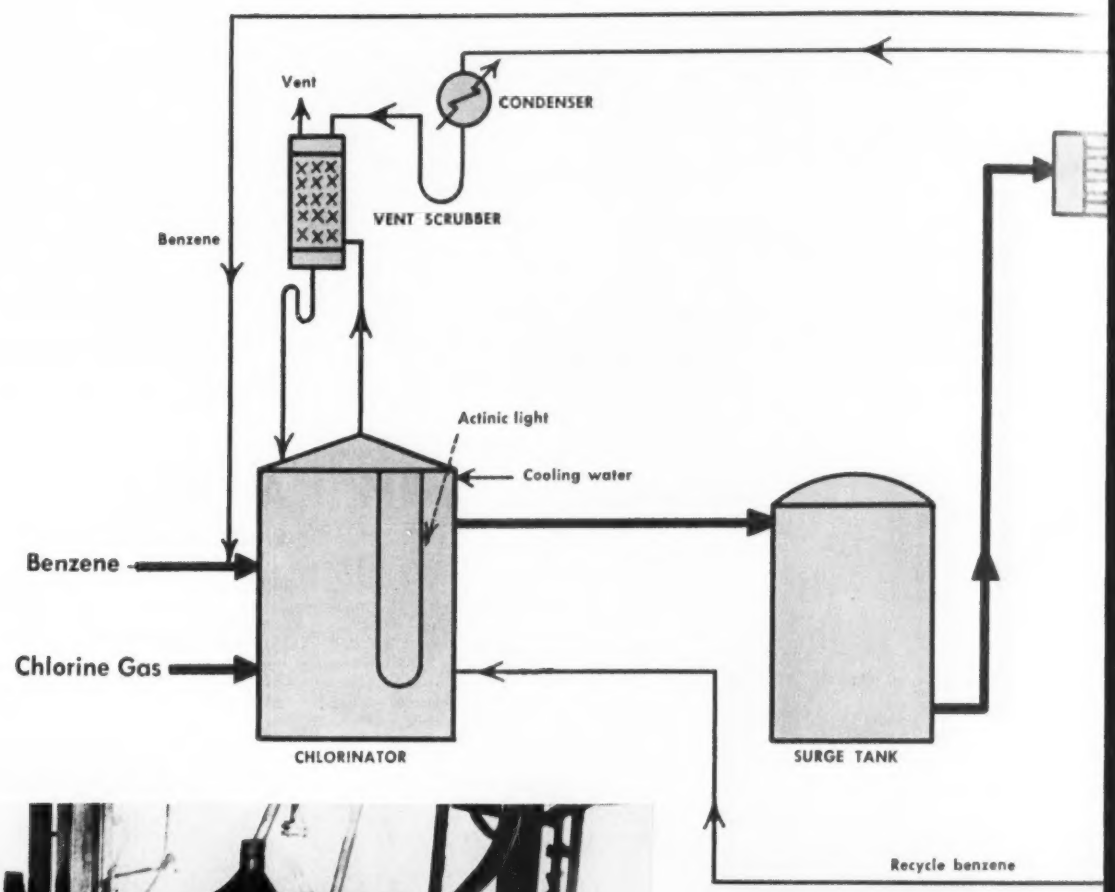
More recycle benzene comes from heating the filter cake following crystallization of the α and β isomers.

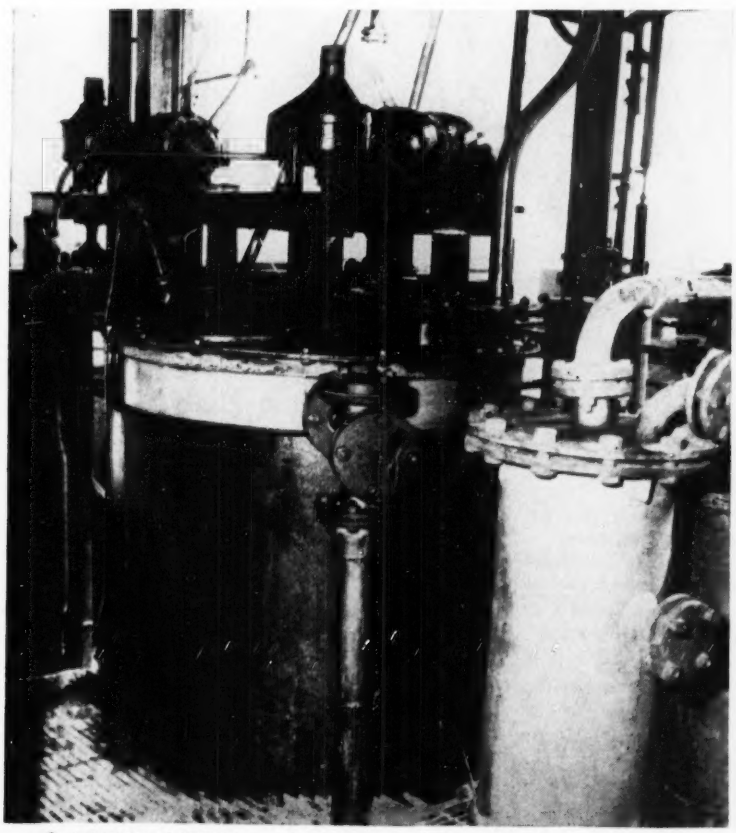
▶ **Steam Stripping**—Following filtration, the filtrate flows to one of several steam distillation kettles. Stripping is at 120 C. Here a further amount of recycle benzene is picked up: water-benzene coming out of the stream stripper goes to a continuous phase separator, where it's introduced at the interphase. Anhydrous benezene is produced in an azeotropic drying system, cooled and returned to the chlorinator.

▶ **Final Product**—Liquid product from the steam kettles flows to a molten storage tank—capable of holding a full day's production. This is done to allow time for analysis of each kettle batch, before casting.

Molten product is cast in 8-in. deep, 5 x 5-ft. metal casting pans. Some is sold as lump form; the rest is ground in a hammer mill to minus ¼-in. before being packed in fiber drums for shipment to Stauffer insecticide mixing plants.

Equipment at the plant is lead or lead-lined.

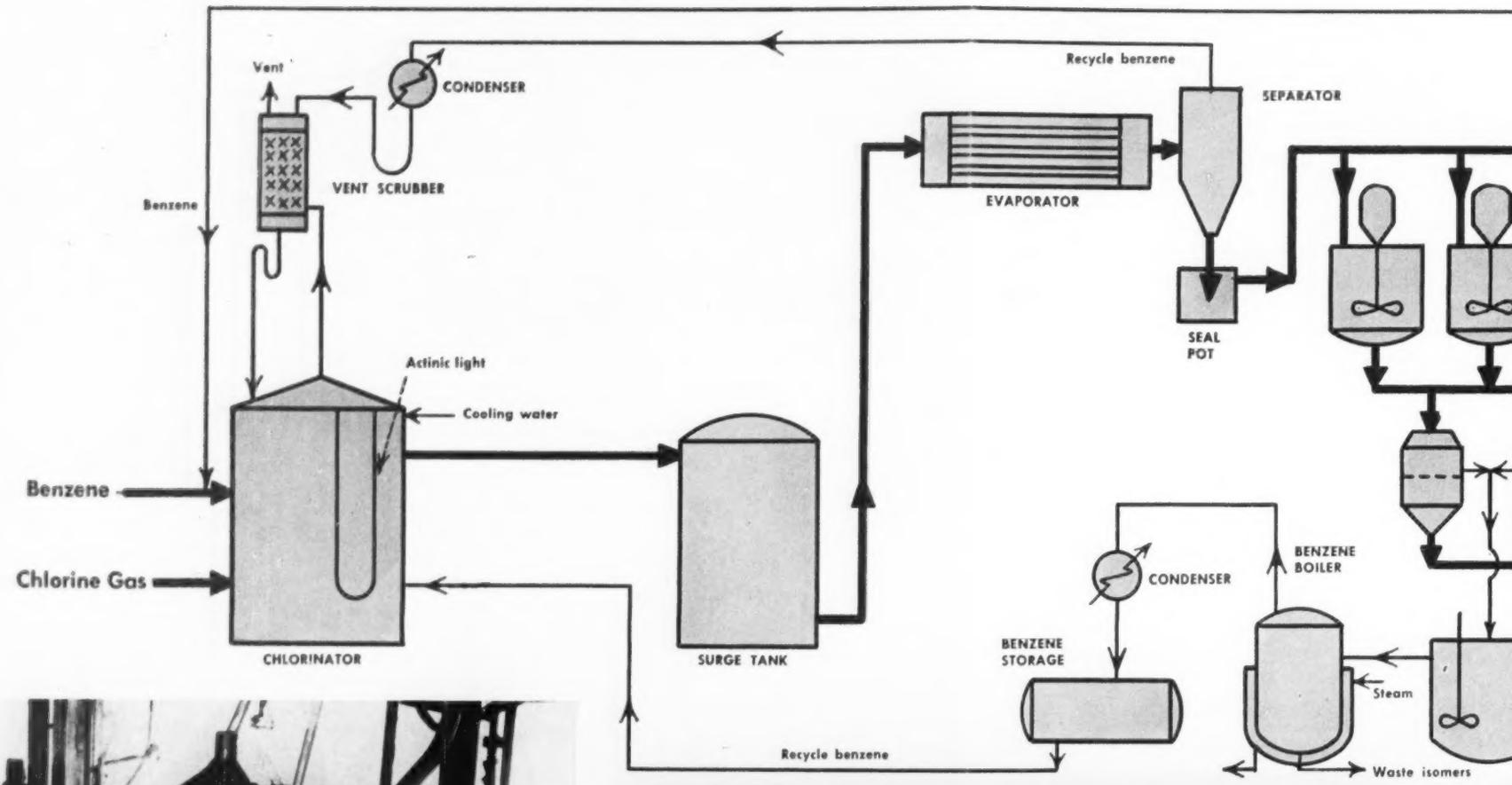


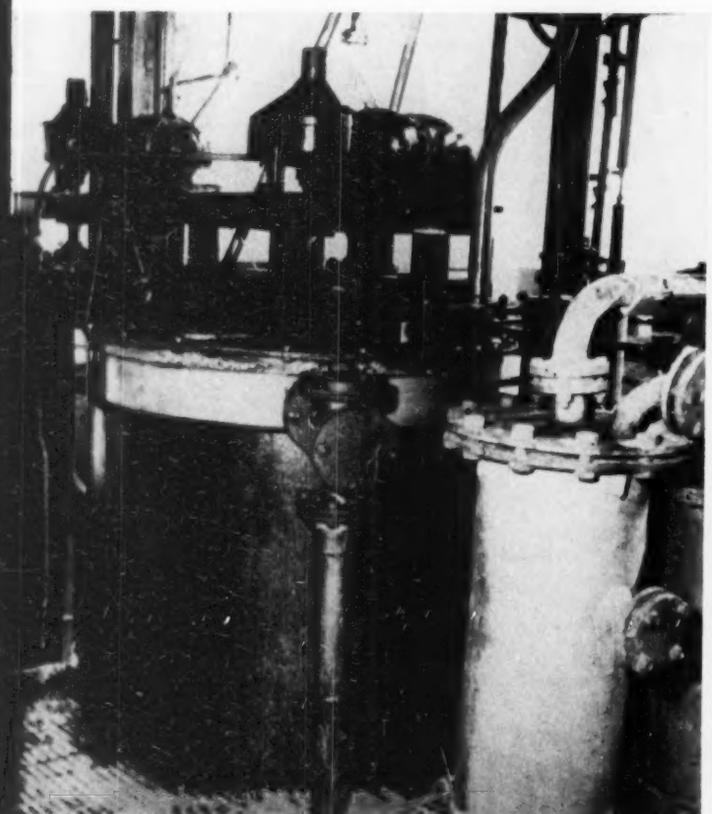


1 CRYSTALLIZERS precipitate out the less soluble alpha and beta isomers from the product of the chlorination and evaporation steps.

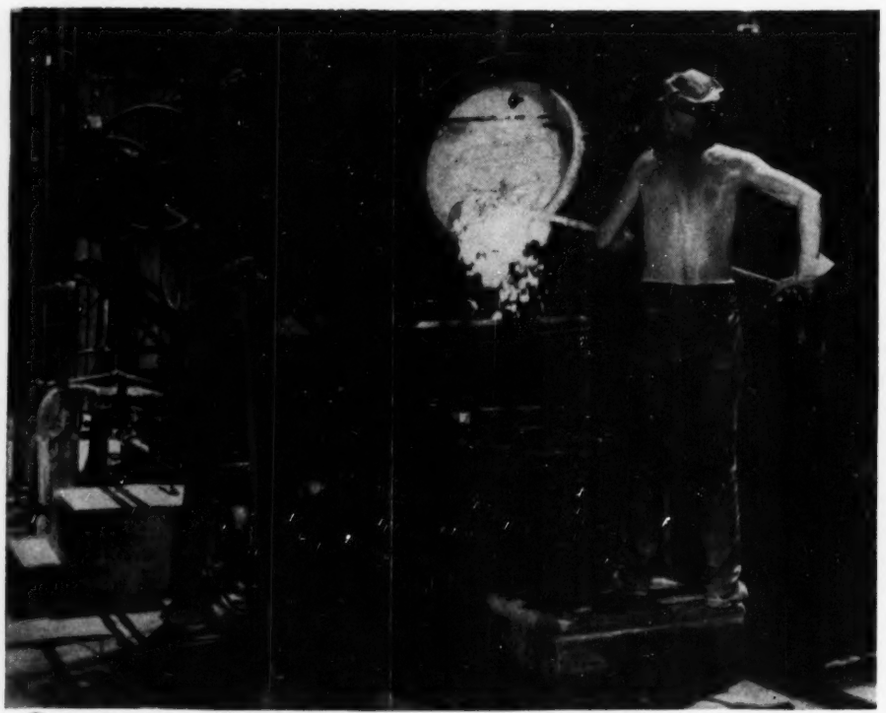


2 TRUNNIONED FILTERS separate t
filtrate. After the benzene content is





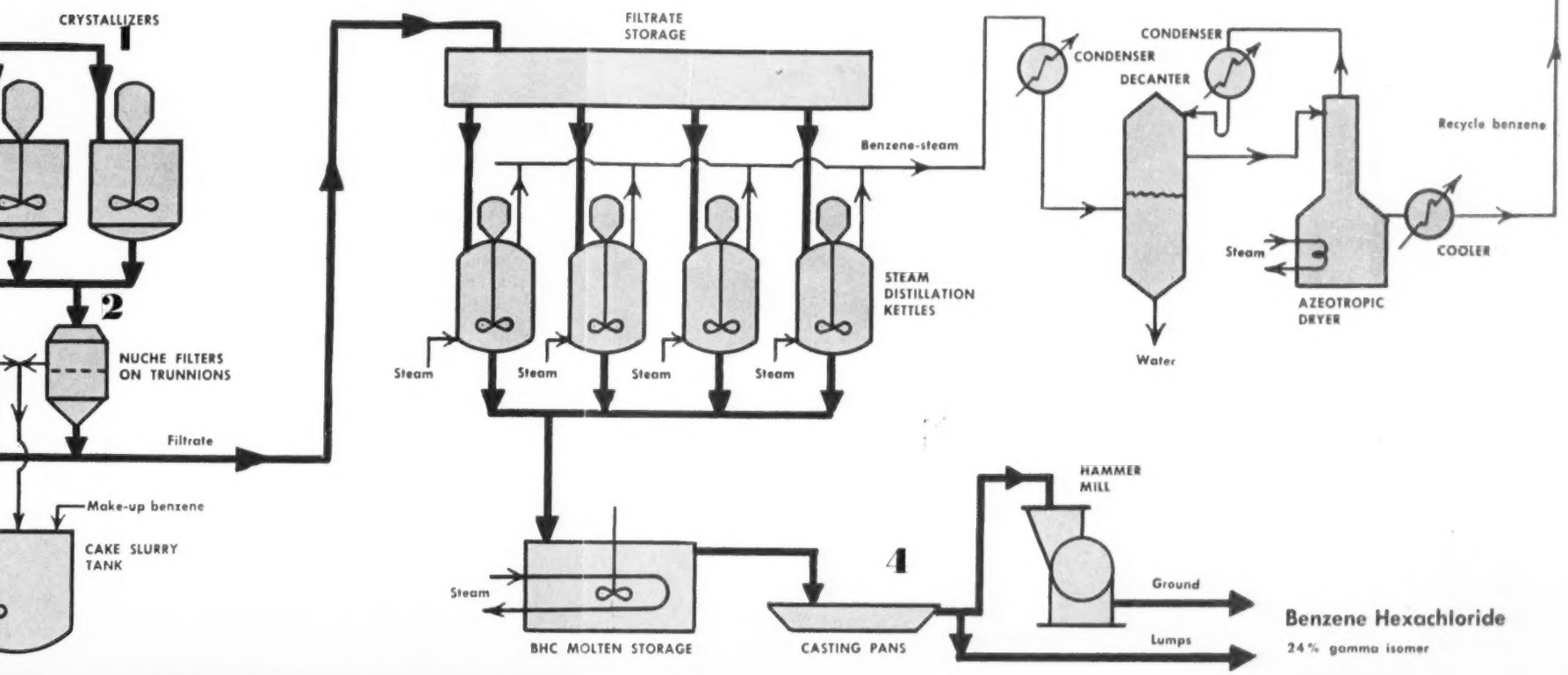
1 CRYSTALLIZERS precipitate out the less soluble alpha and beta isomers from the product of the chlorination and evaporation steps.

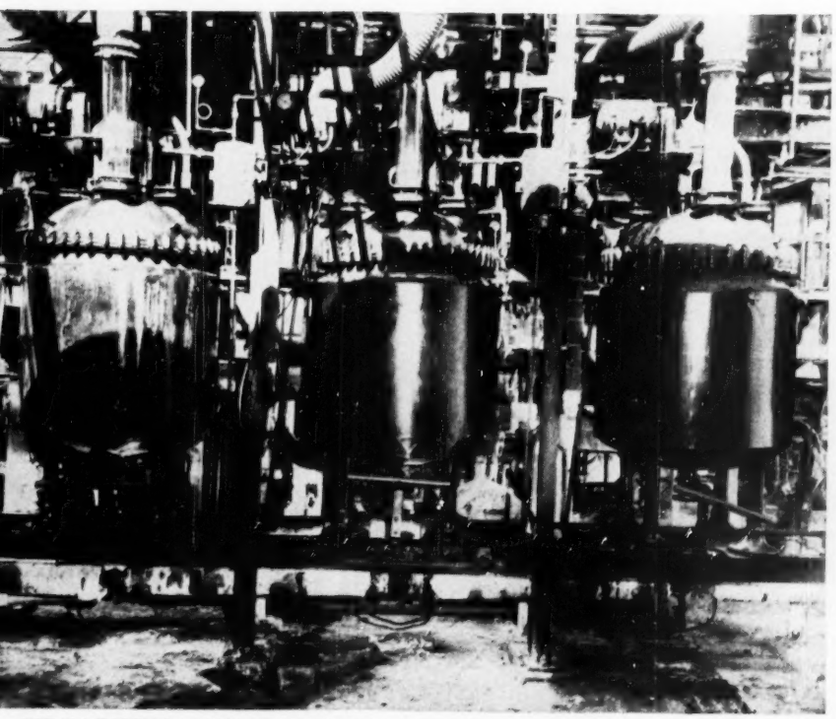


2 TRUNNIONED FILTERS separate the higher melting alpha and beta crystals from the gamma filtrate. After the benzene content is recovered, the cake is discarded.

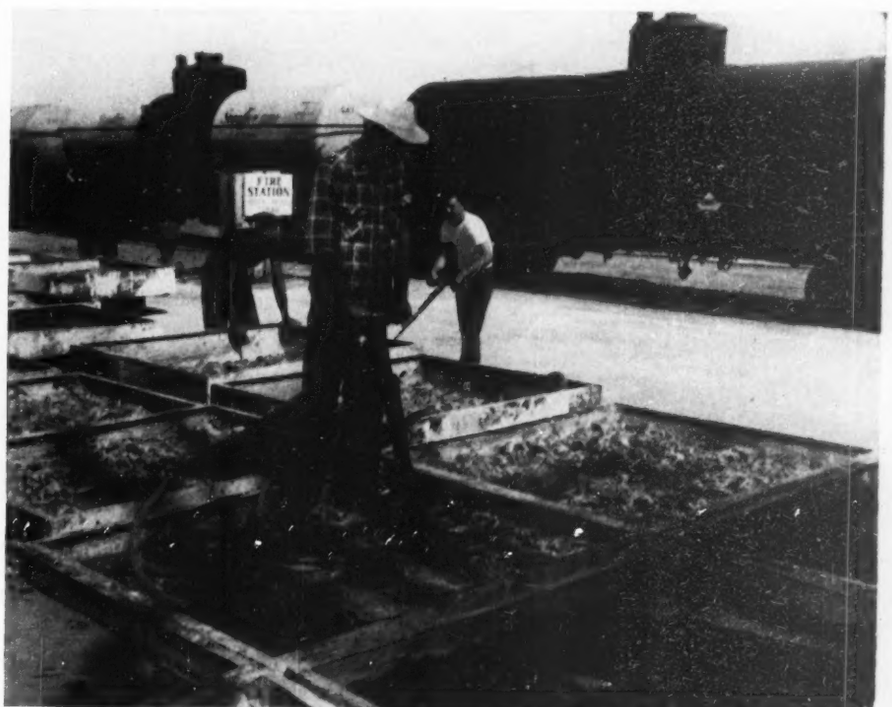


3 ST
uct





STEAM DISTILLATION KETTLES strip the remaining benzene from the 24% gamma product. This steam also liquifies the BHC, which goes from the kettles to storage and casting.



4 CASTING PANS are filled late in the afternoon for overnight solidification. They are chipped out the following morning after the BHC has solidified.



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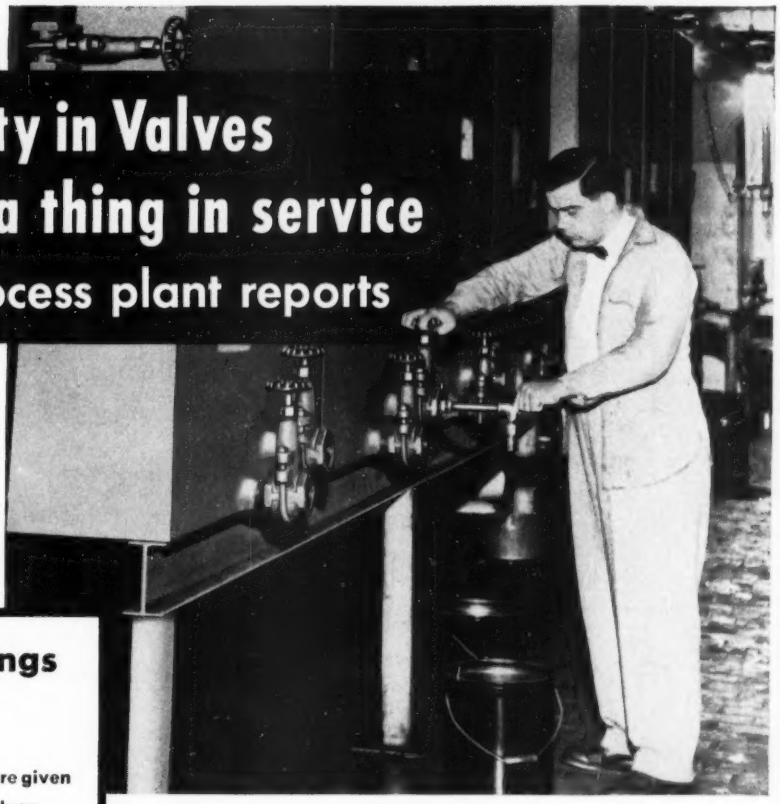
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*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler

Similarity in Valves doesn't mean a thing in service ...Chicago process plant reports



The Installation

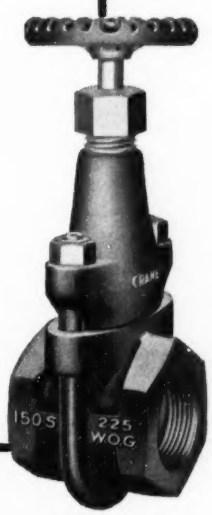
At Hysan Products Co., Chicago manufacturer of liquid waxes, pine oil and coal tar disinfectants, liquid soaps, insecticides and various chemical specialties—where Crane clamp gate valves have been installed on all process and storage piping.

Valve Service Ratings

SUITABILITY: Performance-proved
FEATURES: Tight seating
MAINTENANCE COST: Only routine care given
SERVICE LIFE: Many times former valves—still like new
OPERATING RESULTS: Costly loss and trouble stopped
AVAILABILITY: Crane Catalog item—No. 488

The Valve

Crane clamp gates are of rugged design, with seating surfaces machined to close tolerances. That's why they provide long-lasting, tight closure, even where operation is frequent and fluids are hard to hold. Many patterns to choose from in these compact valves—all iron or brass-trimmed. Consult your Crane Catalog or your Crane Representative.



The Case History

Longest service given by similar type valves formerly used was from 2 to 6 months. They failed to hold tight at seats and disc under daily operation of 3 to 12 cycles. Valve maintenance and replacements were excessively costly—as were down-time losses. Leaky valves on tank lines forced repeated transfer of storage stock. Up to 3 men were needed to make valve repairs.

Only when the plant switched to Crane No. 488 clamp gate valves was the trouble stopped. Installed more than a year ago, the valves show no sign of wear or leakage. Only an occasional pull-up on the packing nut is needed—and only one man for all piping maintenance.

What's the answer? Better quality valves, obviously—the only way to assure better service and lower ultimate cost.

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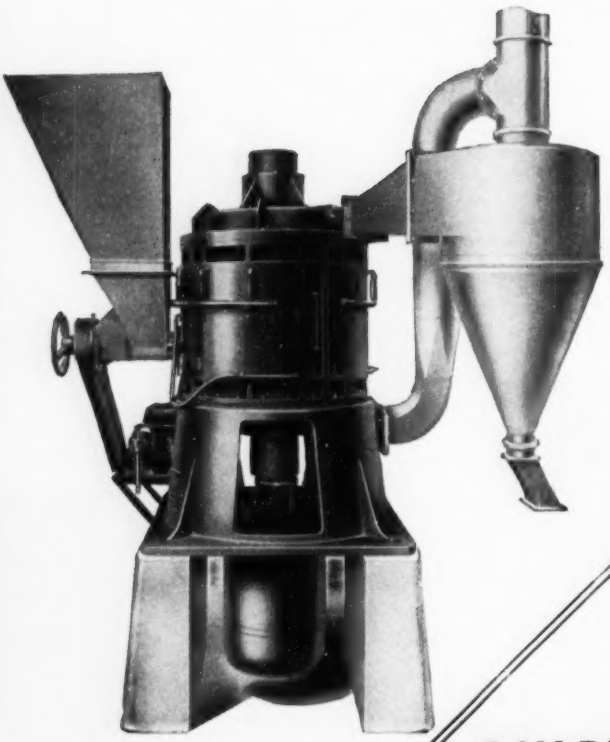
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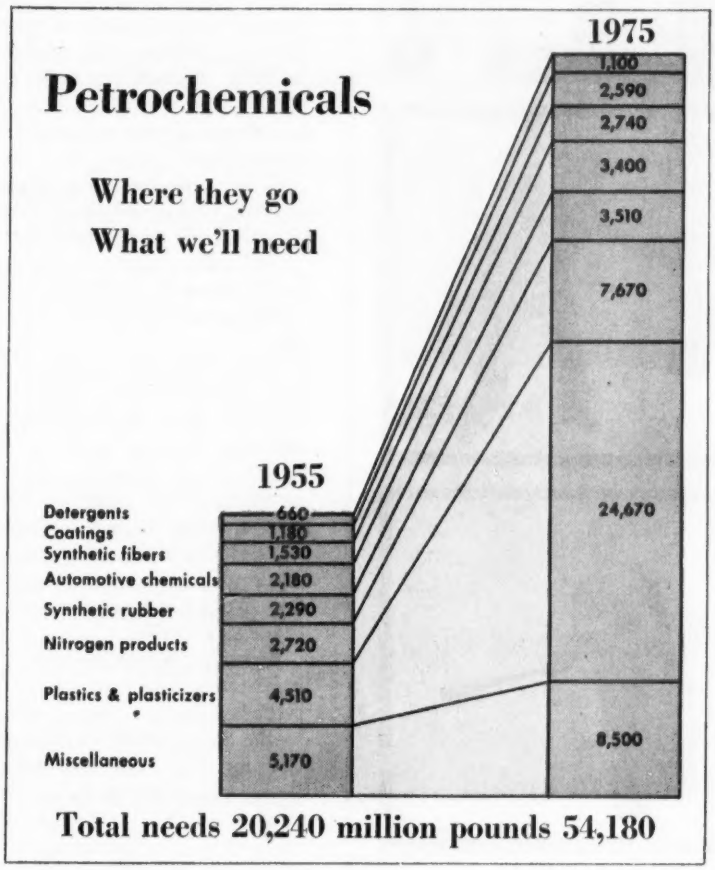
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What's Behind the Forecasts

Just about everybody seems to be getting into petrochemicals. Here's a rundown on the market at stake and why chemicals from oil will be leading the pack.

William H. Chartener, McGraw-Hill Dept. of Economics

Petrochemicals, a new word that has achieved high standing in the chemical vocabulary in just the last few years, will cover half the output of the entire chemical industry by 1965. This forecast, coming from leading experts in both the chemical and oil industries, may be realized even sooner if petroleum and natural gas can maintain their economic attraction as a source of chemicals.

The output of petrochemicals in 1953 reached a record 25.3 billion pounds, an increase of 18% over 1952. This represented 22% of total U. S. production of chemicals by weight, estimated at 114.3 billion pounds. The value of petrochemicals sold by manufacturers in 1953 was $3 billion, already almost half the $6.14 billion value of all chemicals. These figures are estimates just of chemical intermediates and count the carbon atom only once in the course of its processing.*

▶ **What They Are**—Development of petrochemicals has been so rapid that no standard definition of the term has yet taken firm hold. One of the most widely accepted—although the dissenters are numerous—is that suggested by *Petroleum Processing:* A petrochemical is "a chemical compound or element recovered from petroleum or natural gas or derived in whole or part from petroleum or natural gas hydrocarbons and intended for chemical markets."

This definition excludes common petroleum products such as fuels and asphalts, includes both chemicals naturally present and those made by chemical reactions, comprehends natural gas specifically as a source, and eliminates materials used by the petroleum industry itself as fuel or blending agents.

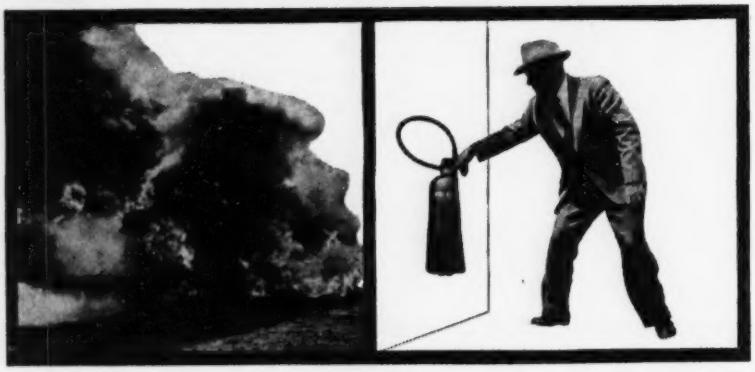
From the end-user's standpoint, the principal difficulty with defining petrochemicals essentially by source in this way is that it may not uniquely identify certain chemicals. "Petrochemical" ammonia made partially from natural gas, for instance, is chemically no different from ammonia made from coal. Thus it makes little difference what you call it as long as the price and quality are right.

There is also dissent from classical scholars, who insist that "petro-" should refer only to rock or stone. But any effort to substitute some such word as "petroleochemical" out of deference to Greek roots seems surely doomed.

▶ **Which Are Tops**—Most important among the petrochemicals now being produced are the aliphatics—derived mainly from C_1 to C_4 hydrocarbons. Petrochemicals accounted for 82% of the 19.7 billion pounds produced in 1953, the remaining

* Estimates supplied by Dr. R. L. Bateman of Carbide and Carbon Chemicals Co. for *Petroleum Processing* (a McGraw-Hill publication), September 1954.

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18% coming from coal and agricultural products.

In the field of aromatics, petrochemicals supplied 47% of the total of 4.7 billion pounds produced in 1953. Aromatics include benzene, toluene and xylene as crudes and phenol, styrene and aniline as intermediates.

Of the vast group of inorganics, however, petrochemicals accounted for only 7.4% of the total output of 89.9 billion pounds. The inorganics–ammonia, carbon black, and sulfur–come largely from natural gas.

▶ **Where They Go**–A listing of the principal end products using petrochemicals shows the basis for the ambitious forecasts made for this branch of the chemical industry. Synthetic rubber, synthetic fibers, plastics, detergents, and automotive chemicals are even now among the top customers for petrochemicals. And all promise tremendous growth in the years ahead.

Probably the best available long-range forecasts of requirements for petrochemicals are those prepared by the Standard Oil Development Co. for the Paley Commission (President's Materials Policy Commission) in 1952. Estimates then made of primary petrochemical requirements, in millions of pounds, for major end uses in 1955 and 1975 were as follows:

	1955	1975
Detergents	660	1,100
Protective coatings	1,180	2,590
Synthetic fibers	1,530	2,740
Automotive chemicals	2,180	3,400
Synthetic rubber	2,290	3,510
Nitrogen products	2,720	7,670
Plastics & plasticizers	4,510	24,670
Miscellaneous	5,170	8,500
Total	20,240	54,180

These forecasts, in terms of primary petrochemicals, differ from Dr. Bateman's shorter range figures, which are for chemical intermediates. The trends of the two series, however, are parallel. In the Paley Commission projections, note particularly the enormous demand anticipated for petrochemicals to be used in plastics by 1975–almost half the total requirements of 54 billion pounds.

▶ **Who Makes Them**–The development and production of petrochemicals attracted the efforts of both chemical and petroleum companies

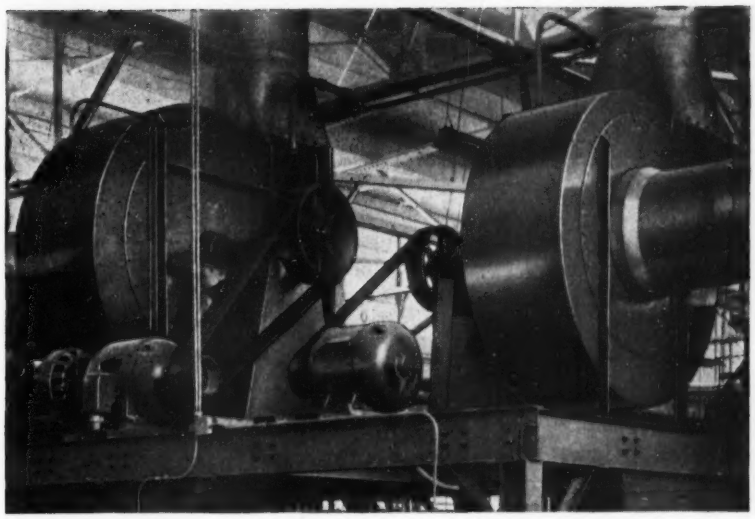
from their birth in laboratories some 35 years ago. The latest survey of petrochemical plants by *Petroleum Processing* (Sept. 1954), indicates that 176 companies are now engaged in making petrochemicals in the U. S. and Canada. This total includes 102 chemical companies, 62 petroleum companies or subsidiaries, 12 joint ventures of the two industries or of undisclosed parentage.

These companies have 322 plants in operation, under construction, or planned. And the current construction program for petrochemical plants is impressive indeed. At least 41 new plants are in the planning or building stages. Within the past year alone, 44 new plants started up. Projected new facilities and expansion programs represent investment estimated at some $730 million.

▶ **Why They're Made**—Petrochemicals' great advantage over competing sources is their assurance of an adequate, stable supply at dependable, frequently lower, prices. This advantage may not work consistently in favor of petrochemicals in the future, but it has contributed greatly to their spectacular strides in recent years.

Despite the large share of petrochemicals in total chemical production, they take only about 1% of the total crude oil processed by the petroleum industry—albeit a profitable 1%. Petrochemical sales of some oil companies run as high as 15% of their total sales, though this use may consume less than 2% of the crude oil handled. Also, the great expansion of petrochemicals ahead will probably not increase significantly their percentage requirements of crude oil production, since the basic uses of petroleum for fuel will be growing too.

Supplies of oil and natural gas both appear to be ample to meet fuel and chemical needs for many years to come. Additions to known reserves are running ahead of consumption of petroleum. Gas reserves in the southwest are estimated as equivalent to 30 years' supply at present consumption rates. And improved technology promises to hold down prices of



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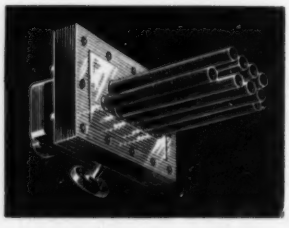
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ECONOMICS . . .

both crude oil and petrochemicals.

► **Price Smoothers**—The relative stability of supply and price among petrochemicals contrasts with earlier experience when some of the same chemicals were produced exclusively from agricultural raw materials—always subject to the vagaries of nature.

Acetone, to take one example, ranged from 12¢ to 25¢ a lb. when wood or corn was the principal source. Since the late 1930s, when petroleum began to be dominant as the source, the price has ranged within a cent or two of 8¢.

Natural gas does not have so certain a future as crude oil for petrochemical production. The rising popularity of natural gas for fuel purposes is gradually pushing its price beyond the economical limit for production of many chemicals. A price of 20¢ per Mcf. is enough to discourage use of gas for some items and 25¢ might start a mass shift to other sources.

In some cases, such as carbon black, ammonia and ethylene, the shift may well be to petroleum. Coal, however, may challenge both natural gas and petroleum if improvements in hydrogenation and readjustment of price structures restore its competitive strength.

Chemical Industry Gears for Pick-Up

Although U. S. chemical markets went through their annual July-August slump, a definite upswing is looked for this fall. According to McGraw-Hill's *American Letter*, summer output was generally lower than in 1953, but prices stayed at about last year's level. Chemical exports are substantially higher than a year ago, imports are down Here is a partial survey of the chemical market.

► **Caustic Soda and Soda Ash**—Unlike most products, there was no seasonal dip in demand this year. Outlook is for high prices to continue for many months.

► **Fats and Oils**—Surpluses continue to climb in government storehouses. Lard prices soared with wide-spread drought in the Midwest, then dropped as the rains came. The

soybean business remained slow.

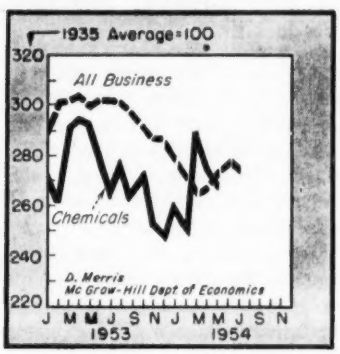
A bright spot is that American farmers are using tallow in mounting tonnages as a feed additive for animals. The government estimates that first quarter consumption in 1954 hit 16 million lb., a tremendous boost over 1953. If demand continues at present rates, look for a price rise soon of about 2½¢ a lb.

▶ **Fertilizers**–Despite the fact that summer is an in-between season for farm buying, prices stayed high for anhydrous ammonia and ammonium sulfate. Output was cut in some plants, however.

▶ **Insecticides** – Demand has been disappointing for DDT and BHC. Newer compounds (Aldrin, Dieldrin, Parathion, Malathion), however, enjoyed brisk sales.

▶ **Industrial Alcohol** – Prices were steady through the summer and dealers forecast a generally firm market for the rest of the year.

CONSUMPTION INDEX . . .



Business Activity (July)....276.7

Chemical Consumption

	June (Prelim.)	May (Rev.)
Index	267.1	269.8
Fertilizer	55.38	60.94
Pulp & Paper	31.84	31.95
Petroleum Refining	27.10	28.37
Iron & Steel	13.51	13.71
Rayon	26.90	25.92
Glass	25.07	25.83
Paint & Varnish	31.71	29.60
Textiles	9.18	9.71
Coal Products	11.83	9.88
Leather	4.02	3.90
Explosives	8.41	8.00
Rubber	6.27	5.84
Plastics	15.87	16.17





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Engineers and Principal Builders: The H. K. Ferguson Company

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The Ceilcote Company is equipped to contract for an entire installation or for labor or materials only. We welcome the opportunity of studying your individual coating needs so that the best material for the job may be recommended.

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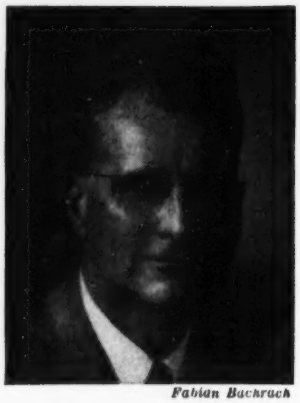
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THIS MONTH'S

Names in



Fabian Bachrach

Ernest H. Volwiler

MAN OF THE MONTH

Head of Abbott Laboratories is this year's Society of the Chemical Industry medalist.

Dr. Ernest H. Volwiler, who rose from research chemist to president of Abbott Laboratories, is this year's recipient of the Chemical Industry Medal–annual award of the American Section of the Society of the Chemical Industry.

In presenting the award this month, the society cites Dr. Volwiler for his "conspicuous services to applied chemistry," and notes that he is being recognized for the prominent role he has played in the development of the synthetic drug industry–from its precarious birth in World War I, through its turbulent adolescence in the 20's, to its vigorous maturity in the past decade.

▶ **Made an Early Mark**–It didn't take Volwiler long to make his mark in the fledgling industry. In 1918, a month before receiving his doctorate, he came to Abbott from the University of Illinois and soon found himself working day and night on the development of processes to produce procaine and barbital for our fighting forces.*

* Today, Abbott is the world's largest manufacturer of procaine, and an important producer of barbituates.

the News

P. C. Shaw

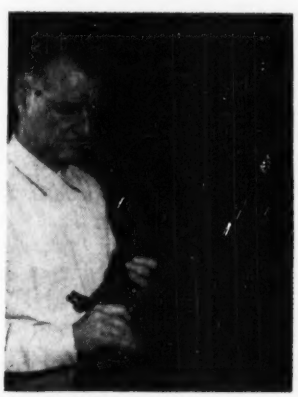
Suddenly cut off from our German suppliers of these drugs by the war, there was little time for extensive laboratory work or pilot planting to guide the scale up to production. So Volwiler brought a cot to work and practically took up residence in the plant, while working round the clock keeping an eye on the reactions and gathering necessary data.

▶ **Climbed Steadily**—Some two years after his hectic initiation to the synthetic drug industry, Dr. Volwiler became Abbott's chief chemist. And about a decade later he became the company's director of research.

In 1933 he took over as Abbott's vice president in charge of research and development. He became executive vice president after World War II and four years ago he was named president and general manager of the company.

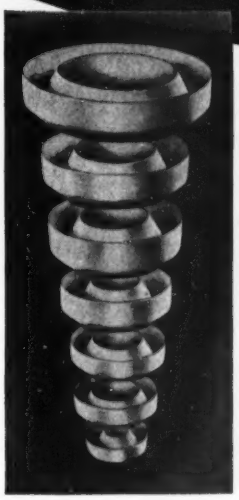
▶ **A Hard Worker**—Though his jobs have changed through the years Volwiler's working habits remain essentially the same. He still gets to work before most of his coworkers; leaves after they do. He sees workers on all three shifts almost every day.

Very concerned with promptness, he'll often phone his colleagues for immediate conferences just about the time they're taking

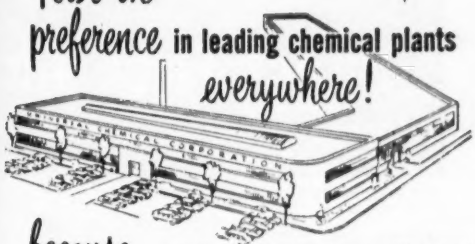


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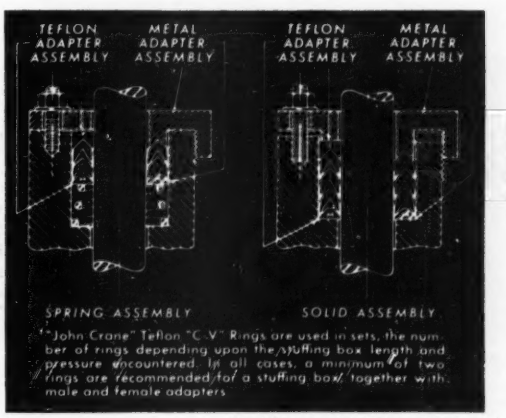


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Why repack with ordinary materials when corrosively inert "John Crane" Teflon "C-V" Rings will effectively seal any hydraulic fluid, including the newly developed synthetics, and resist high temperatures as well. Also, they have extremely low friction characteristics—will not shrink, swell, harden, dissolve, corrode or deteriorate. Ideal for use on all valve stems and reciprocating pumps as well as many centrifugal and rotary pump applications. Cross-section design allows effective sealing at finger-tight gland pressure.

"John Crane" has developed a complete line of standard size Teflon "C-V" Rings and male and female adapter rings to meet practically every need. If you have special requirements, "John Crane" can mold additional sizes to fit your stuffing box requirements.



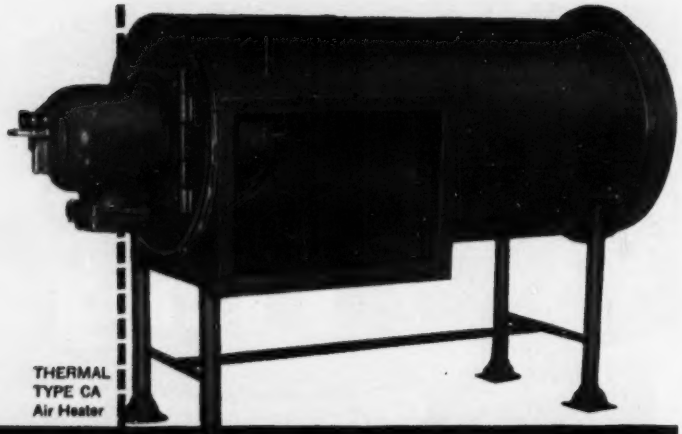
"John Crane" Teflon "C-V" Rings are used in sets, the number of rings depending upon the stuffing box length and pressure encountered. In all cases, a minimum of two rings are recommended for a stuffing box, together with male and female adapters.



Send for complete information, including this illustrated technical booklet, "The Best in Teflon."
Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, Ill.
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

* Du Pont trademark

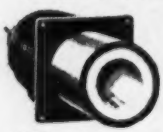
JOHN CRANE
CRANE PACKING COMPANY



Direct Fired Air Heaters

COMPACT . . . ECONOMICAL . . . HIGHLY EFFICIENT

May be fired with any THERMAL burner



OIL



GAS



COMBINATION

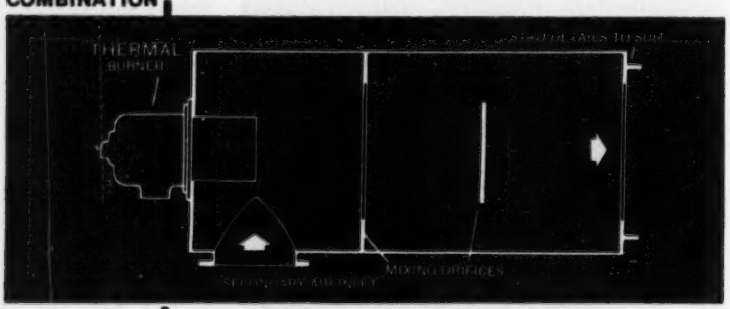
EASILY INSTALLED . . . EASILY ADAPTED

Readily fitted to ovens, kilns, spray dryers, etc., the THERMAL Type CA Air Heater is an ideal source of heat where products of combustion may be mixed with the air. Units for operation against high pressure are available in the same simple design as those for atmospheric pressure levels.

NO REFRACTORY REQUIRED . . .

The THERMAL High Velocity Burner built into the Type CA Air Heater provides for combustion to be substantially completed within the burner itself. Thus the heater is basically a mixing chamber wherein the products of combustion are mixed with the air being heated. Refractory is not normally used in the heater.

FOR DETAILED INFORMATION WRITE FOR BULLETIN 104



OTHER THERMAL PRODUCTS AND SERVICES . . .

Gas and Oil Burners • Combination Gas-Oil Burners • Heat Exchangers
Submerged Combustion • Combustion & Heat Transfer Engineering

THERMAL

Thermal Research & Engineering Corp.

CONSHOHOCKEN • PENNSYLVANIA

REPRESENTATIVES IN PRINCIPAL CITIES

NAMES . . .

off their hats. Yet his staff hail him as a true leader–not a pusher.

His multitude of "extracurricular" activities also give a clue to his working habits. He has been extremely active and has held many offices in both professional and trade societies.

▶ **Golden Mean** – Hard worker though he is, Volwiler's outstanding characteristic is his relaxing normalcy. He's active and enthusiastic in many fields, but a fanatic in none, and it's pretty evident that he generally seeks Aristotle's "golden mean" between extremes.

He relaxes in a number of easy-going, non-fanatical ways. An occasional golf game, a day of pheasant hunting or fishing are about the extent of his active participation. A skillful amateur photographer, he takes pictures–usually carefully chosen scenic shots–in both color and black and white.

His gun room holds a pretty fair collection, a few of which he picked up in Europe while a member of a Chemical Warfare Service investigative team in Germany. Dr. Volwiler also has an interesting collection of medallions struck to commemorate historical events.

▶ **At Home**–The Volwilers have lived in their present home in Highland Park, Ill., for about 15 years. Their two daughters and son spent their teens in this house. Although the clamor of the "gang's" voices is gone, the Volwilers are by no means lonely for their home is still the family gathering place.

Lillian, his wife, is a charming hostess and an excellent business helpmate. The two of them enjoy a shopping trip for plants and the later pleasure of adding them to the garden. Also in the garden is a barbecue pit where friends are frequently entertained during the warmer months.

▶ **Greatest Service**–One associate has said of him, "His greatest service has been his ability to forecast trends and needs and to sense the potentialities of embryonic developments."

This is quite evident. Nembutal, a barbiturate developed by Volwiler and an assistant over twenty years ago, is still a widely used hypnotic.

Pentothal, discovered shortly afterward, was of tremendous aid in World War II for easing the pain of wounded en route to hospitals and continues to be widely used.—HTS

J. E. Hollis, Jr.—Plant engineer of Orange, Tex., plant of Allied Chemical & Dye Corp.

Charles E. Dryden—Assistant professor in chemical engineering dept. at Ohio State University; formerly assistant chemical engineering chief at Battelle Memorial Institute, Columbus.

M. T. O'Shaughnessy—Leader of Viscose Research section, and **Joseph E. Ross,** head of experimental spinning; both in research and development department of American Viscose Corp. at Marcus Hook, Pa.

Jack M. Andrews—Senior research chemist in research and development division at Baytown, Tex., refinery of Humble Oil & Refining Co.

Kenneth A. Roe—Executive vice president of Burns and Roe Inc., New York.

Howard R. Spendelow Jr.—Assistant director of research of Metals Research Laboratories, Electro Metallurgical Co., New York.

George T. Atkins—Engineering associate at Baytown refinery of Humble Oil & Refining Co.

L. John May—Plant manager of National Foam System Inc., of West Chester, Pa.

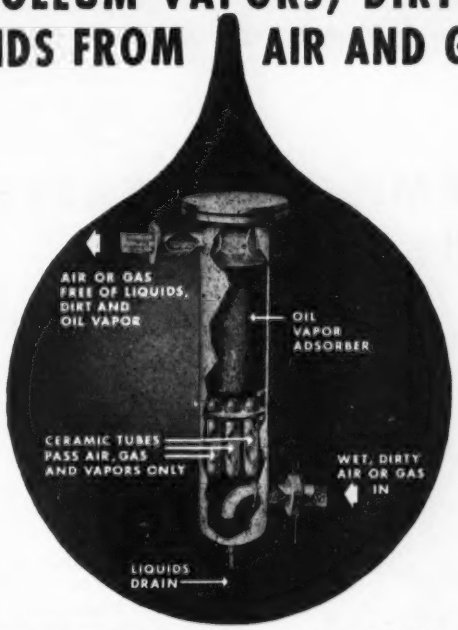
Wayne E. Kuhn—General manager of research and technical department of the Texas Co.; **James V. C. Malcolmson** and **Theodore A. Mangelsdorf,** general managers of marine and refining departments respectively.

C. M. Vanderwaart—Staff assistant to chief chemical engineer, **William Kruppa; George J. Marlowe**

SELAS

VAPE-SORBER

CONTINUOUSLY REMOVES PETROLEUM VAPORS, DIRT AND LIQUIDS FROM AIR AND GASES



Its double action removes water, oil, emulsions and dirt with liquid-impervious ceramic filters which freely pass air without significant drop in pressure. Petroleum vapors are then removed by adsorption. Result: conditioned air and gases for maximum instrument accuracy and process efficiency.

Numerous critical processes . . . including liquid aerations and agitations . . . compressed air for drying and cleaning . . . instruments and pneumatically operated mechanisms . . . rely on the Vape-Sorber for clean air or gas.

Selas Vape-Sorbers are built to last! No moving parts. Filters and chambers are easily cleaned and replaced. No other maintenance necessary.

GET THIS BOOKLET



Please send me Bulletin SC-1047 on new Selas Vape-Sorber.

*Name*_____ *Title*_____

*Company*_____

*Address*_____

SELAS CORPORATION OF AMERICA
PHILADELPHIA 34, PENNSYLVANIA

Outlast other gaskets 10 to 1

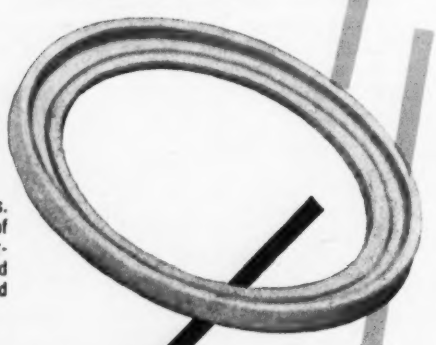


Chemiseal TEFLON-Jacketed Gaskets, Types 1-339WA and 10-339WA. Compressed asbestos, sandwiched between woven asbestos, enclosed in a TEFLON envelope. Ideal for glass-lined steel connections. Seal at low bolt loads.

CHEMISEAL GASKETS made of Teflon



Chemiseal TEFLON-Jacketed Gaskets, Types T6N or T6-300. Standard for Corning conical flanges. Seal at low bolt loads. Sizes for all conical-flanged glass pipe from 1 in. to 6 in.



Chemiseal Snap-on Type 820 Gaskets. Molded of TEFLON to match contour of conical-end glass pipe, they assure perfect, automatic centering of joints and free flow of materials. For all standard pipe sizes from ¼ in. to 6 in.

Write for Catalog No. TG-953.

UNITED STATES GASKET COMPANY

CAMDEN 1 • NEW JERSEY

FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS

Representatives in Principal Cities Throughout the World

NAMES . . .

–department chemical engineer for heavy chemicals; **Francis K. Maples**–operating supervisor of the central pilot plant. All three promotions made in the chemical engineering section at American Cyanamid's Organic Chemicals Div. plant in Bound Brook, N. J.



Harry J. Collyer

Technical represenative for continental Europe and the British Isles, for Godfrey L. Cabot Inc. of Boston. Mr. Collyer will transfer his headquarters to Cabot Carbon Limited, at Stanlow, England.

Stanley M. Boxler–Manager of the Harvey, La. plant of Continental Can Co.

E. Finley Carter–Vice president and technical director of Sylvania Electric Products, Inc.; formerly with Stanford Research Institute.

Edgar E. Wrege–Leader of experimental engineering section of the research and development department of American Viscose Corp.

E. K. Stevens–President of the International Exposition Co., succeeding the late **Charles F. Roth.**

Charles T. Silloway–President of Warner-Chilcott Laboratories, pharmaceutical division of Warner-Hudnut, Inc.

Robert W. Clarke–Manager of new Pennsylvania Salt Mfg. plant at Delaware, Ohio.

Bernard Wolnak—Heading his own consulting and research organization, known as Mid-West Laboratories, Chicago.

Charles Franklin Kettering—Elected to board of trustees of the Southern California Air Pollution Foundation.

George M. Allen—Assistant to manager of research and development department of American Viscose Corp.

William C. Goggin—Honored by degree of doctor of science from Alma College, Alma, Mich.; he is manager of Dow Chem. Co.'s Plastics Technical Service.

L. H. Byrd—Assistant superintendent of Humble Oil, Midland, Tex.; transferred from Humble's California plant.

Royce J. Noble—Vice president of Rubatex Products Inc.; consulting engineer in rubber and latex industry since 1931.

Bernard Daubert—Technical director of scientific dev. in central labs of General Foods, White Plains.

George M. Walker—Elected to board of directors of MCA; vice president and general manager, chemical div., Koppers Co., Pittsburgh.

Thomas Sumner—At 28 named head of Akron University Chem. Dept., which is composed of ten faculty members and 700 students.

Francis H. Horn—President of Pratt Inst., Brooklyn, former executive secretary of the Assn. for Higher Education.

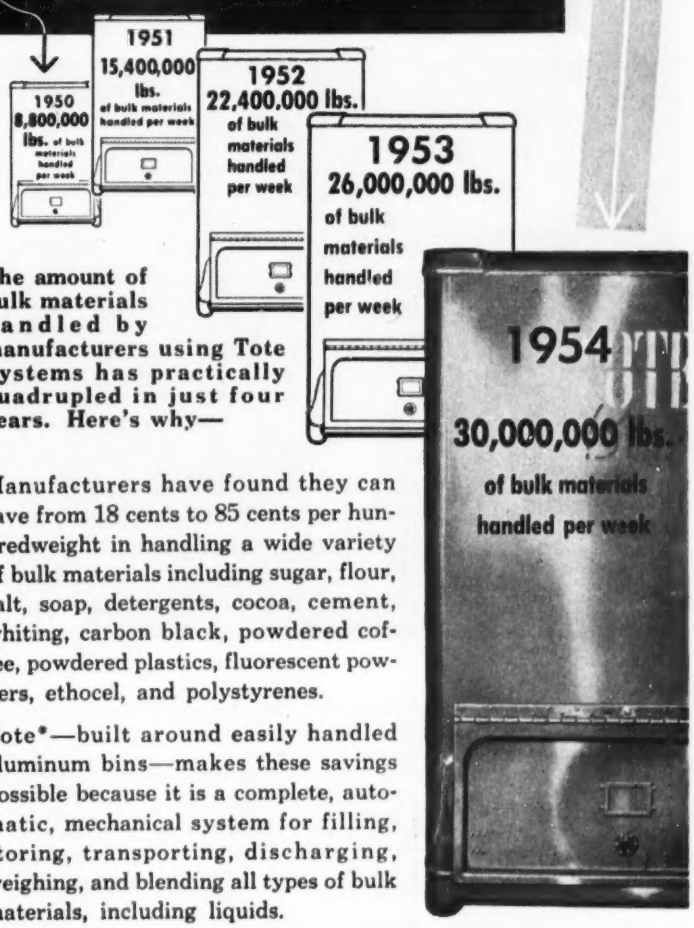
John J. O'Connell—Reelected president of SPI; president of Consolidated Molded Products Corp., Scranton.

Thorndike Saville — Awarded Lamme Medal of ASEE "for excellence in teaching . . . and

TOTE SYSTEM*

(complete bulk material handling system)

is going places



The amount of bulk materials handled by manufacturers using Tote Systems has practically quadrupled in just four years. Here's why—

Manufacturers have found they can save from 18 cents to 85 cents per hundredweight in handling a wide variety of bulk materials including sugar, flour, salt, soap, detergents, cocoa, cement, whiting, carbon black, powdered coffee, powdered plastics, fluorescent powders, ethocel, and polystyrenes.

Tote*—built around easily handled aluminum bins—makes these savings possible because it is a complete, automatic, mechanical system for filling, storing, transporting, discharging, weighing, and blending all types of bulk materials, including liquids.

Tote saves on labor costs, container costs, storage costs, freight claims, product loss, product contamination and deterioration, and inventory. It is equally effective for in-plant or inter-plant operations.

Write for Illustrated Literature

TOTE SYSTEM, incorporated

600 So. 7th, BEATRICE, NEBRASKA

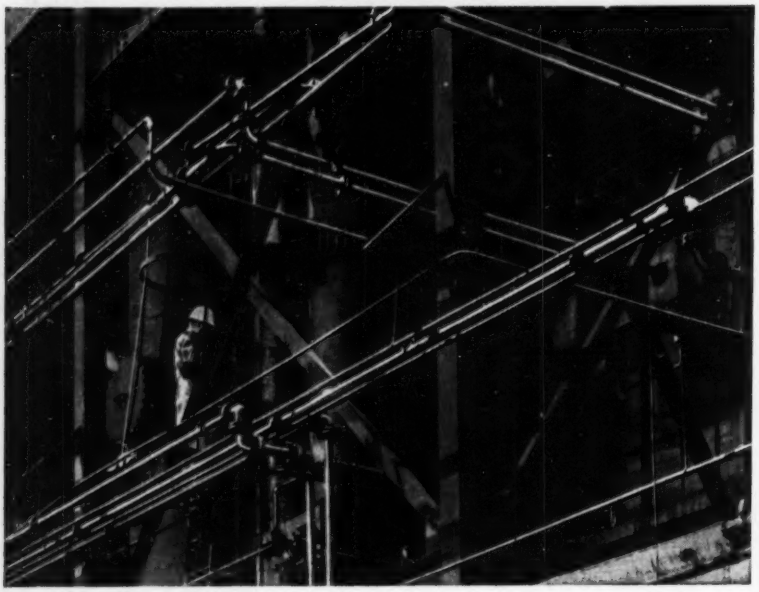
Tote Engineers will survey your plant to determine the savings you can effect, at no cost or obligation.

*Tote and Tote System Reg. U. S. Pat. Off.

DOW

IN SERVICE FOR SEVEN YEARS ...STILL RESISTANT TO CORROSION!

That's the record of these Saran Lined Pipes, Fittings and Valves used by a large company to convey hydrochloric acid



The seven-year record of the above installation tells you why it's smart to use saran lined pipe, valves and fittings for conveying corrosive liquids.

The strong, corrosive-resistant lining of this steel-clad pipe has eliminated costly shutdowns due to corrosion. The joints have remained as airtight and leak-proof as new. Its high pressure strength means greater safety, too, for there's no danger of this pipe bursting.

Installation was easy, also. Saran lined pipe can be cut and threaded on the field, without need of special tools; and because of rigidity, *a minimum of structural supports are needed.*

If your production operation requires the handling of corrosive chemicals or solvents, saran lined pipe, fittings and valves are your best answer. For further information contact your nearest Dow sales office or write Saran Lined Pipe Company, Burdette Ave., Ferndale, Michigan.

RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

Saran Lined Pipe Company
2415 Burdette Ave.,
Ferndale, Michigan

Please send me a copy of your catalog on saran lined pipe, valves and fittings.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

SP 1168A

you can depend on DOW PLASTICS DOW

NAMES . . .

achievements which contribute to the advancement of the engineering profession." Dr. Saville is dean of NYU's College of Eng. and a former president of ASEE.



Robert B. Wittenberg

Vice president of Great Lakes Carbon Corp., New York City, and general manager of electrode division. Prior to this post, Mr. Wittenberg was connected with General Tire & Rubber, Akron; International Minerals and Chemicals, Chicago; Mathieson Alkali, New York; and Grasselli Chemical, Boston.

Sheldon L. Levy—Manager of applied physics division at Midwest Research Institute.

W. D. Kohlins—Director of Engineering, Buflovak Equipment Division of Blaw-Knox, Buffalo.

Thomas Sumner—At 28 named head of Akron University Chemistry Dept., which is composed of ten faculty members and seven hundred students.

Fred J. Emmerich—Chairman of the Board of MCA and president of Allied Chemical & Dye Corp.

William E. Wade—Technical director of Acme-Hamilton Mfg. Co.

Meritt F. Myers—Plant manager of Ferrod Manufacturing Co., Batavia, Ill.

W. D. Morrison—Assistant to director of development department of Celanese Corp. of America.

Charles F. Gates—Chief production engineer, General Petroleum Corp. production departments.

Ralph W. Kumler—Consultant on staff of Foster D. Snell, New York, in field of pulp and paper industry chemical problems.

John P. Termini—Research engineer in ion exchange techniques, Permutit Co., New York; formerly with the AEC Process Development Branch in New York.

Robert A. Staniforth—Manager of chemical development in Monsanto's inorganic chemicals division, Dayton, Ohio.

John B. Gray—Assistant resident manager, Rayonier Inc., Port Angeles, Wash.

O. M. Hayden—Recipient of the award of merit from ASTM for his work on rubber and rubber-like materials. Mr Hayden is manager of Du Pont's Rubber Chemicals Div., Technical Section.

OBITUARIES

George T. Trundle, Jr., founder and chairman of the board of the Trundle Engineering Co., died on July 16.

Leon H. Johnson, 69, chief engineer of the Warren Division of Struthers Wells Corp., died on June 8. He was the holder of several patents for chemical processing equipment.

Murray Girvin, research chemist for Western Condensing Co., Petaluma, Calif., died July 16 after contracting bulbar polio.

Richard T. Anderson, vice president of the Paterson Parchment Paper Co. of Bristol, Pa., died in Lawrenceville, N. J., on August 9.

IS LIQUID CARRY OVER-

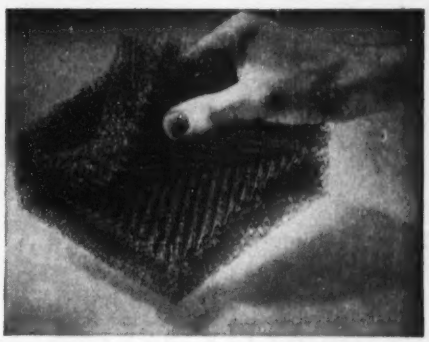
LIMITING YOUR PRODUCTION?

AFFECTING PRODUCT PURITY?

CUTTING INTO YOUR PROFITS?

IF SO

GET THE FACTS ON METEX MIST ELIMINATORS!

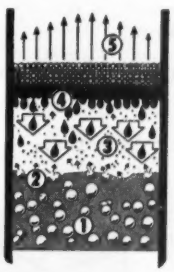


Section of a METEX MIST ELIMINATOR, opened to show construction. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained. They can be made of practically any metal, to combat corrosion.

These separators, which are made from layers of knitted wire mesh, literally "filter out" the liquid droplets by impingement and accumulation in depth (see diagram). The liquid is returned by gravity: The gas passes on freed from the unwanted—and often contaminating entrainment.

METEX MIST ELIMINATORS can be easily installed in new or existing vessels. Special housings are not needed, and they have no moving parts to require power and servicing. They will function over an unusually wide range of velocities with a pressure drop generally well under 1" of water. Efficiencies of 99% and over are commonly reported.

While liquid entrainment is an inevitable result of practically any processing operation involving the handling of liquids and gases together, it need no longer be considered as an unavoidable evil. It can be controlled simply, effectively and economically – by a Metex Mist Eliminator, as more and more engineers are finding from experience.



When a gas is generated in or passes through a liquid (1) it carries with it on leaving the surface (2) droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC entrainment problem.

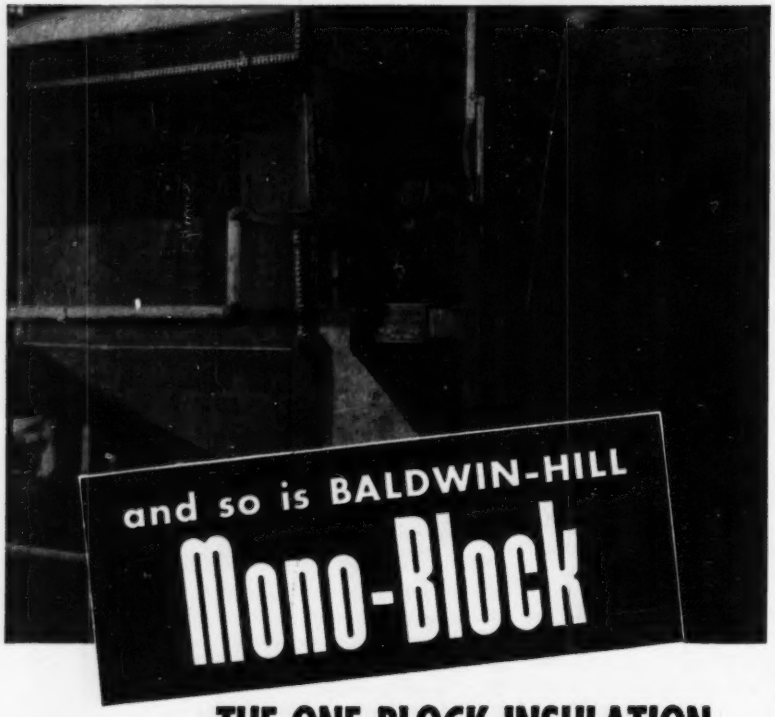
METAL TEXTILE CORPORATION

KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

METEX

Roselle, New Jersey

Chemical Engineering **is a problem solver**



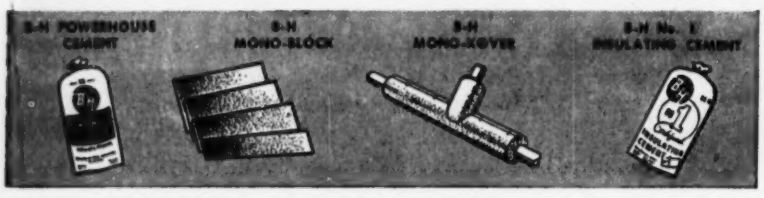
THE ONE-BLOCK INSULATION FOR TEMPERATURES UP TO 1700°F

- One Block application instead of two.
- Light in weight, easily cut with a knife to fit odd shapes.
- Impales over studs, clips, or wires.
- Low thermal conductivity because of unique felted structure.
- Forms strong bond with insulating cements.

Baldwin-Hill COMPANY
1510 BREUNIG AVE., TRENTON, N. J.
Kalamazoo, Mich. • Huntington, Ind. • Temple, Tex.

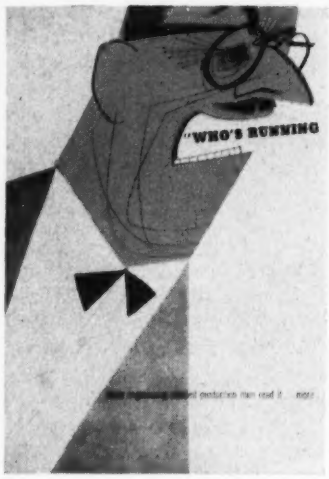
Send for bulletin with data on composition, properties, efficiency and low applied cost.





THIS MONTH'S

Letters:



To 19 Cringing Editors

Sirs:

It's not often I air my views, but the ad on p. 238-9 (see cut above) of your July issue struck a responsive chord.

Sure, it is expensive to "push" your readers into replying and to help you in planning your magazine. But for several hours I've been cutting articles from CE and the ease with which the pages fit together, with no advertising in the way, was making me wonder if such "luck" was accidental.

So, here is an unsolicited letter of congratulations. I have enjoyed CE and am finding more articles of interest each month.

Thanks for keeping an ear to the ground.

MILTON SPOOR

Chicago 26, Ill.

▶ *The ad reproduced above, which has drawn an unusual number of comments, begins: "Nineteen editors cringed, the ad director stumbled into the waste basket. . . ." then goes on to tell how it's really our readers who determine what we do and how we do it, and concludes "How can you make a contribution? That's easy . . . just write us your ideas, suggestions and criticisms."*

Last month Milton Spoor and several hundred other readers sent in their suggestions (see typical letters below. The invitation's still open!—ED.

Pro & Con



Amen to Bonnett

Sir:

Amen to Mr. Bonnett's suggestion! Your new format is excellent. I only wish any of the other periodicals did as good a job as you do. . . . Reader Service is superb!

A. M. GRIFFITH

Research Laboratories
Alexander Smith, Inc.
Yonkers, N. Y.

▶ *Vote to date has been 3.7:1 against continuing odd-page feature articles to another section of the issue so as to make them fileable as complete units without destroying adjacent material of a reference nature. Close to 90% of all our feature articles can now be filed without damaging other reference editorial material at all.*—ED.

Are We Ready!

Sir:

I'll take you up on your invitation to send in my suggestions and criticisms. Are you ready?

• Cut out more of the empty wordiness in your articles. You've made some progress in recent months, but still have a long way to go (as do all other technical chemical publications).

• Publish more practical articles (like "Shortcut to Heat Exchanger Design" in July) and less of those general pieces like "Breakdown vs. Preventive Maintenance"

HERE'S THE *New* RUPTURE DISC FOR BS&B SAFETY HEADS...

...ESPECIALLY DESIGNED FOR USE IN LOW PRESSURE APPLICATIONS UNDER SEVERE CORROSIVE CONDITIONS!



For many years the problem of producing a low pressure rupture disc that could withstand prolonged exposure to severe corrosive conditions was a perplexing one. Yet, it was a problem that *had* to be solved, particularly for the Process Industries.

Therefore, it was only natural that BS&B — originator of the Safety Head — should come up with the right answer in the form of a flat type rupture disc whose bursting pressure is controlled by a top metal section, isolated from the corrosive contents of the protected vessel by a sealing membrane of Teflon or Kel-F.

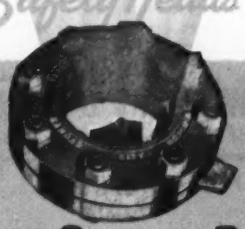
If back pressure is not anticipated, the bottom metal section of the disc is cut open to full relieving capacity (Model 1A). However, if a vacuum support is needed, the bottom metal section is constructed similar to the top section to serve as a vacuum support (Model 1B). Top and bottom sections are spot welded together to give a single compact unit.

Disc Models 1A and 1B are constructed of corrosion-resistant metals such as Inconel, stainless steel, nickel, Hastelloy B and Monel. Either model is available in 2", 3", 4", 6", 8" and 10" sizes. Pressure ratings are from 8 to 100 lbs. Close design tolerances are an inherent feature of this type disc.

If you have a pressure relief problem which you have not been able to solve satisfactorily with the regular pre-bulged type of disc or other types of relief devices, try the new BS&B Model 1A or 1B disc. It fits any standard size BS&B Safety Head flanges you may now have in service. Also available in a complete assembly consisting of inlet and outlet flanges, rupture disc, studs and nuts.

Your BS&B Man will be glad to give you details . . or you may write for descriptive literature and prices.

BS&B Safety Heads

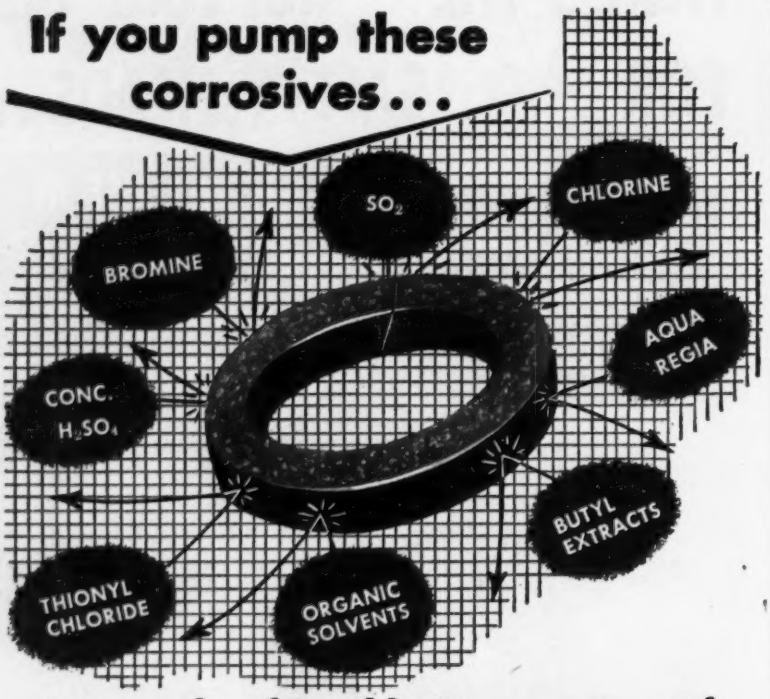


THE "CIRCUIT-BREAKER" OF Pressured Systems

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-N10
7500 East 12th Street, Kansas City 26, Mo.

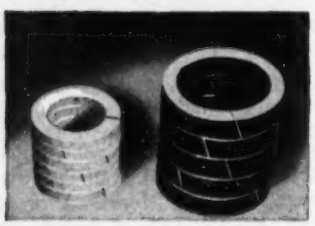
If you pump these corrosives...



Get months of Trouble-Free service with

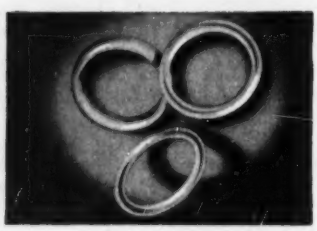
CHEMPRO TEFLON PACKINGS

If your pumps and valves handle highly corrosive industrial chemicals, CHEMPRO TEFLON PACKINGS will drastically cut packing replacement and maintenance costs. CHEMPRO Packings *last for many months* under corrosive conditions which make ordinary packings useless in days or even hours. They stop leakage by providing a tight seal at only slight gland pressure, and their very low coefficient of friction often makes lubrication unnecessary.



TEFLON* PLASTIC STUFFING BOX PACKING

Ideal for either centrifugal or reciprocating pumps operating at speeds up to 3600 R.P.M. handling corrosives at temperatures from -118° F. to 525° F. Style No. 101 composed of 94% shredded Teflon and chemically inert graphite as a friction reducer. Style No. 201 same as No. 101 except that mica is used as friction reducer. Both styles made to fit every size stuffing box on standard process equipment.



TEFLON V-TYPE PACKINGS

For reciprocating pumps and hand, air and motor operated valves handling corrosive materials. Lips of very sensitive pressure rings expand proportionately to increased operating pressure thereby preventing leakage. Suitable for temperatures from -150° F. to 550° F. Unsuitable for centrifugal or rotary pumps. Supplied in bulk or in complete sets to fit specific stuffing boxes.

Chemical & Power Products engineers are packing and gasket specialists with complete fabricating facilities to meet your specific requirements. Write for our complete Teflon Packing and Gasket Catalog.

*duPont Trademark

CHEMICAL & POWER PRODUCTS, INC.

The Original Fabricators of Teflon Packings and Gaskets

5 Broadway, New York 4, N. Y.

PRO & CON . . .

that don't say much of anything.

• Use color more often in your graphs; they stand out and add life and emphasis.

• Keep up, by all means, your leadership in publishing the "cost" series of articles for chemical engineers.

• Stay practical, dammit; you're getting dangerously intimate with theory at times.

• Your "Names" section is a waste of time, "Technical Bookshelf is dull and "You & Your Job" is silly. Otherwise you're fair to mediocre.

KENNETH S. WELLS
Engineer
Allied Chemical & Dye Corp.
New York, N. Y.

▶ *Were we ready? Well, not quite. But maybe there's some truth to what the man says.*—ED.

Axiomatic With Advertisers

Sir:

Just want to let you know, in response to the invitation in your August issue (pp. 162-63), that I approve of the new arrangement for ads and editorial pages that you have recently developed.

It's true the concentration of full editorial pages lets me find what I'm interested in faster, makes it easier for me to read both editorial and advertisements thoroughly and allows me to clip and file selected material without destroying the rest of the book.

I suspect you've broken a precedent, but what do advertisers say?

JOHN SHINN
El Segundo, Calif.

▶ *Most of our advertisers agree with what we've done to minimize the mixing of editorial and advertising on the same page. They realize (propaganda from certain quarters notwithstanding) that the worth of a publication to advertisers stems only from the service it renders to its readers. Anything that increases the readership of CE's editorial pages increased the value of its ad pages. That's axiomatic.*—ED.

ABC, Pro & Con

Sir:

Here's my ABC, pro-and-con letter for CE:

• **I like**—(1) Two-color drawings; they're easier to catch, like the one on p. 144, July; (2) odd-page features backed with ads only; (3) all the advertisements at the end; (4) drawings instead of pictures whenever possible; (5) keep publishing the excellent reports like "Lubrication" in July, (6) the useful Plant Notebook, which should be enlarged since it also makes us feel more like a part of the magazine.

• **I Don't Like**—(1) Ads and editorial on the same page since this adds 50% to the volume and weight of clipped articles; (2) ads between a 2-page article; it's our job to read the ads, but I don't like to be interrupted when I'm reading an interesting article; (3) to-be-continued articles; (4) continued-on-on page-xxx type of articles.

• **I Don't Care About**—(1) Guided Tour (I'm sorry); title should be enough to show what the article's about, which is usually the case.

I hope this ABC will be useful to you and to us.

THOMAS GARCIA BORRAS
Chief Chemist
Petroleos Mexicanos
Poza Rica, Mexico

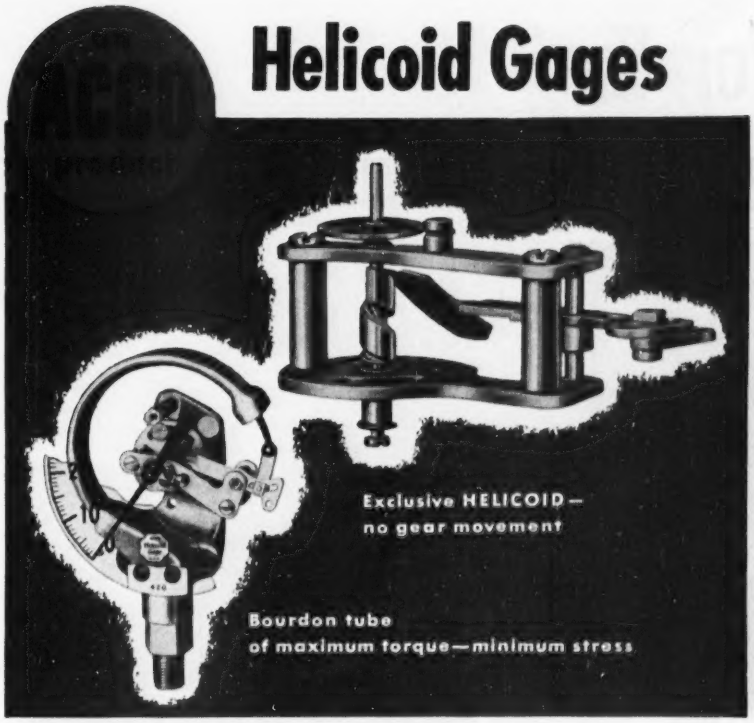
▶ *These suggestions, typical of those made by other readers, have been helpful to us indeed. We've already made progress in chiseling away at those "don't likes (see For Your Files on p. 3 in our September issue).*—ED.

No Way to Treat . . .

Sir:

On p. 134 of your July issue you make the following statement: "Sulfur Production Begins on Pacific Coast. . . . First commercial output of sulfur on the West Coast began recently when Texas International Sulphur Co. opened its new plant at San Felipe, Baja California, Mexico."

Please refer to the July 26 issue of *Chemical Week* for an ad showing that Parsons has designed and built four sulfur recovery plants in Southern California. The sulfur manufactured by these plants is sold to other companies. In my book this is also commercial sulfur





Why HELICOID Costs Less Per Gage, Per Year

HELICOID Gages have many unique and exclusive features which result in enduring accuracy and savings in maintenance cost. They cost less per gage, per year.

Only HELICOID Gages, for instance, have the Helicoid Movement . . . a simple cam and roller design which has no gear teeth to wear out. Bourdon tubes used in HELICOID Gages are carefully designed to give maximum torque and minimum stress . . . promoting the greatest possible endurance life. They withstand many millions of pressure pulsations without stretching, leaking or cracking.

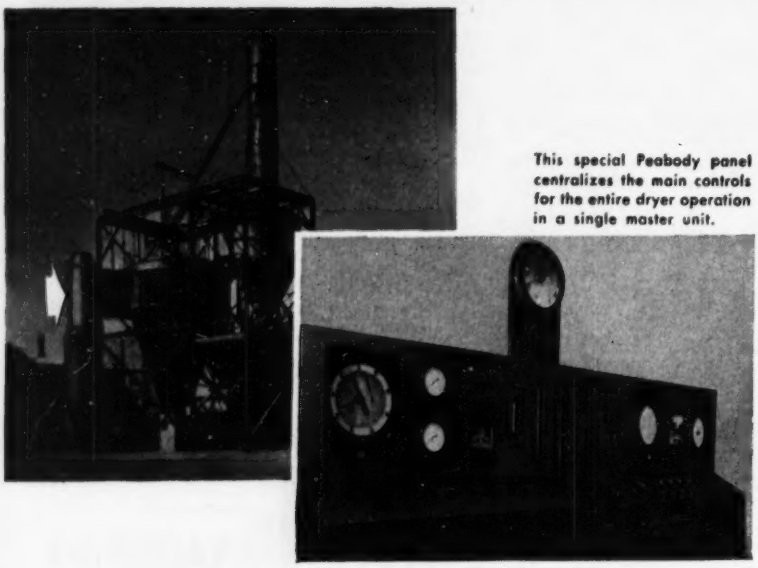
There is a HELICOID long-life gage to meet every type of pressure control requirement. Pressure ranges to 20,000 psi, vacuum or compound. Dial sizes: 3½", 4½", 6", or 8½". Dials may be black, white or radiant faces. They are supplied for wall or stem mounting, flush or panel mounting, or flangeless.

All HELICOID Gages are fully guaranteed. They are time-tested and proved in years of hard service. They assure the highest degree of gage accuracy and long-life service.

Write **TODAY for the G-2 HELICOID Gage Catalog**

ACCO
Helicoid Gage Division
AMERICAN CHAIN & CABLE
927 Connecticut Avenue • Bridgeport 2, Connecticut

for the essential drying medium



This special Peabody panel centralizes the main controls for the entire dryer operation in a single master unit.

The three largest capacity Spray-Dryers in the world depend on PEABODY!

ONCE AGAIN...a custom-engineered Peabody Direct Fired Air Heater has been selected by one of industry's leading process designers. This unit supplies hot gas to a dryer which evaporates over 30,000 lbs. of moisture per hour under unique and exacting conditions.

Peabody, with more than thirty years of designing successful combustion equipment for all types of fuels, plus world-wide experience in the application to direct fired air heating, delivered an efficient, compact and *dependable* air heater. In service, this unit *actually surpasses specified operating requirements.*

If you have a difficult or unusual processing problem involving high temperature gases, look to Peabody for a sound engineering solution.

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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 36, N. Y.
Manufacturers of all types of combustion equipment: direct-fired air heaters, gas scrubbers, coolers, and absorbers

OFFICES IN PRINCIPAL CITIES
PEABODY LIMITED • LONDON, S.W.1, ENGLAND

PRO & CON . . .

production on the Pacific Coast.

Was ist los? This is a fine way to treat . . .!

FREDERICK G. SAWYER
Ralph M. Parsons Co.
Los Angeles 14, Calif.

▶ *Yes, we'll admit this is no way to treat an old friend and a capable representative of one of the nation's leading designers and builders of sulfur-recovery facilities.*

By the way, Parsons has been busy with pilot plant work on a new process for recovering sulfur from low-grade native ores. Its something that should make news in its own rights pretty soon.—ED.

Compressibility Charts

Sir:

The set of generalized compressibility charts by Nelson and Obert are excellent and the article is particularly attractive when done in two colors as you presented it in the July issue.

I am wondering if reprints of this article will be available. . . . Although we use Hougen and Watson's "Chemical Process Principles" and their C.P.P. charts, there are a considerable number of schools that use other books that do not have the compressibility charts in such form that they can be used readily. I am sure that such schools would welcome having this reprint available so that it could be sold to their students.

KENNETH A. KOBE
Dept. of Chemical Engineering
University of Texas
Austin, Texas

▶ *This letter was one of a number which convinced us we should reprint this article from our July issue (pp. 203-208). Reprints of these five compressibility charts are now available at special prices in bulk orders from instructors. Write to Reprint Dept., Chemical Engineering, 330 W. 42nd St., New York 36.*—ED.

Conveyors for Explosive Dusts

Sir:

The April report in *Chemical Engineering* on conveyors and elevators (pp. 195-210) doesn't mention the dust explosion hazard as one of the factors requiring consideration in selecting conveyors.

I believe you'll find that this is very often a critical factor and leads to the selection of en masse conveyors in many cases where this is the only consideration in their favor.

Example: thermosetting plastic resins are poorly suited to this type of conveying system because frictional heat may cause a certain amount of polymerization with consequent binding of the conveyor and necessity for frequent cleaning. But because of the explosive nature of the dust, these conveyors are used; some have been equipped with water jackets at considerable additional expense in order to dissipate frictional heat.

Table IX on p. 209 is incomplete so far as Designation S (explosive dust hazard) is concerned. I'm sure of the following omissions and there may be others:

Alfalfa meal
Powdered bakelite
Castor bean meal
Bone black
Spent dry brewers grain
Casein
Bituminous coal fines
Bituminous coal slack
Copra meal
Fine ground cork
Corn germs
Corn grits
Corn sugar
Corn meal
Cottonseed meal
Granulated gelatin
Coffee chaff
Ground rubber
Powdered or granulated shellac
Soap powder
Granulated sugar
Glutin meal
Dry ground malt
Malt meal
Dried flake milk
Malted milk

Saltpeter is listed as having a dust explosion hazard. Tests by the Bureau of Mines show that such is not the case unless, of course, the saltpeter is contaminated with organic material.

Much property damage has been done and many lives have been lost as a direct result of improper selection of conveying methods for potentially explosive dusts. . . .

W. H. DOYLE
Chemical Engineer
Factory Insurance Association
Hartford, Conn.

► *We appreciate the additional information from Mr. Doyle on the dangers of dust explosions as they are tied in with the selection of conveyors. His data supplement Harry Straube's popular 16-page report on conveyors and elevators in our April issue.—*ED.



Tube Cleaners

Wilson brings you a complete line of fast-acting tube cleaners. They handle every kind of deposit, hard or soft, thick or thin or variable in depth. Driven by air, steam, water or electricity, these powerful cleaners make quick work of cleaning straight or curved tubes.

Tube Expanders

Wilson Tube Expanders are precision-made. Their smooth, efficient rolling action insures firm seating of the tube . . . provides perfectly rolled joints . . . reduces time-wasting re-rolling and re-inspection. There is a Wilson Tube Expander for every need from $\frac{3}{16}$" ID to 12" ID and up.

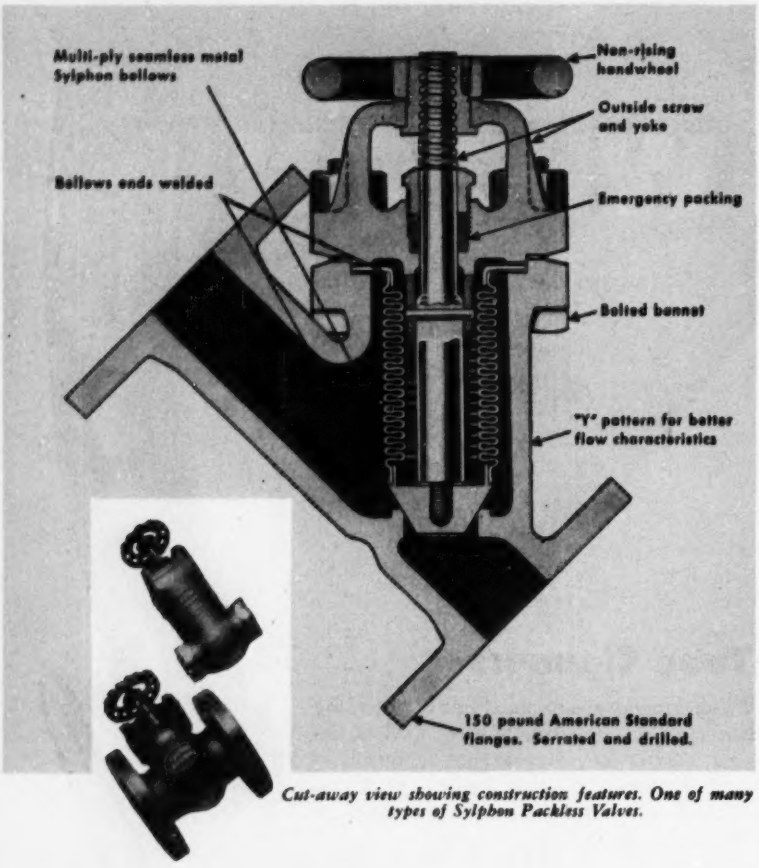
Special Tools

Wilson also offers a wide range line of boiler maintenance and erection tools. The handy chamfering tool shown at right chamfers the tube edge to a 45° surface at high speed . . . makes repairs much faster than outdated hand methods. Also available is an inside chamfering tool for placement of chill rings. Write for more information on these tools.

Representatives in all principal cities

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Cut-away view showing construction features. One of many types of Sylphon Packless Valves.

Prevent pipeline leakage in or out—for sure! *with* Sylphon Packless Valves

Wherever pipelines carrying gasoline, oil, or other volatile liquids and vapors must have positive protection against leakage, install Sylphon Packless Valves and forget leakage for good!

There's no packing to leak or replace, because a rugged, seamless Sylphon metal bellows replaces customary packing. The bellows eliminates leaks that might seep past the stuffing box of the best packed type valve. It seals the valve stem against corrosive, dangerous or inflammable liquids or gases. And here's a plus advantage—Sylphon Packless Valves also provide vacuum protection.

Many sizes and types made of brass, monel, stainless steel, etc. A few are pictured here. Widely used in chemical plants, oil refineries, power plants, aboard ships. Ideal as standard equipment. For complete information, write today. Ask for Bulletin TC-813.

Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION • KNOXVILLE 1, TENN.

THIS MONTH'S

Technical

A Stereotyped Book Review[1]

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY. Vol. 12: Sabadine to Stilbestrol. Edited by Raymond E. Kirk and D. F. Othmer. Assistant editors: Janet D. Scott and Anthony Standen. Interscience Publishers, New York. 955 pages. Subscription price $25.

"Once again it is our pleasure to bring to your attention another addition to the valuable[2] and growing[3] series on your reference shelf.

"The editors[4] have again called on recognized experts[5] for latest and best data. The entries[6] cover a segment[7] of current technological practice.[8]

"As usual, chemical engineers will find several[9] general survey articles[10] that are well done. And again there are entries which are too short[11] or too long.[12]

---

1. This stereotyped book review first appeared in Chemical Engineering last March (p. 394). It was prepared as a standard review for the eleventh and subsequent volumes of the Encyclopedia of Chemical Technology. It is here reprinted to announce Vol. 12, just published. Naturally, the footnotes had to be modified somewhat.
2. See *Chem. Eng.*, Feb. 1948, p. 285, for an appraisal of the value of the series.
3. At a rate of about 1.7 volumes per year.
4. Kirk and Othmer (see *Chem. Eng.*, Feb. 1948, p. 285), Scott and Standen (see *Chem. Eng.*, May 1950, p. 261).
5. Seventy. (Vol. 11 had 80.)
6. Fifty-three. (64 in Vol. 11.)
7. Sabadine to Stilbestrol on the backstrip. Actual entries range from Safety to Stilbene Dyes.
8. Mostly American practice is reported. This accounts in part for the widespread interest and the many orders the publishers receive from other countries.
9. Three.
10. Safety, Sewage, Steam.
11. Stibonic Acids and Other Organic Antimony Acids, with the longest title just misses (1.2 pages) being the shortest entry.
12. Silicon, with its compounds and alloys, 145 pages.

Bookshelf

L. B. Pope

"The articles[13] discussing various industry segments[14] are—on the whole—adequately presented and about the right length. Whole industries are covered with the usual attention to timeliness,[15] accuracy[16] and detail.[17]

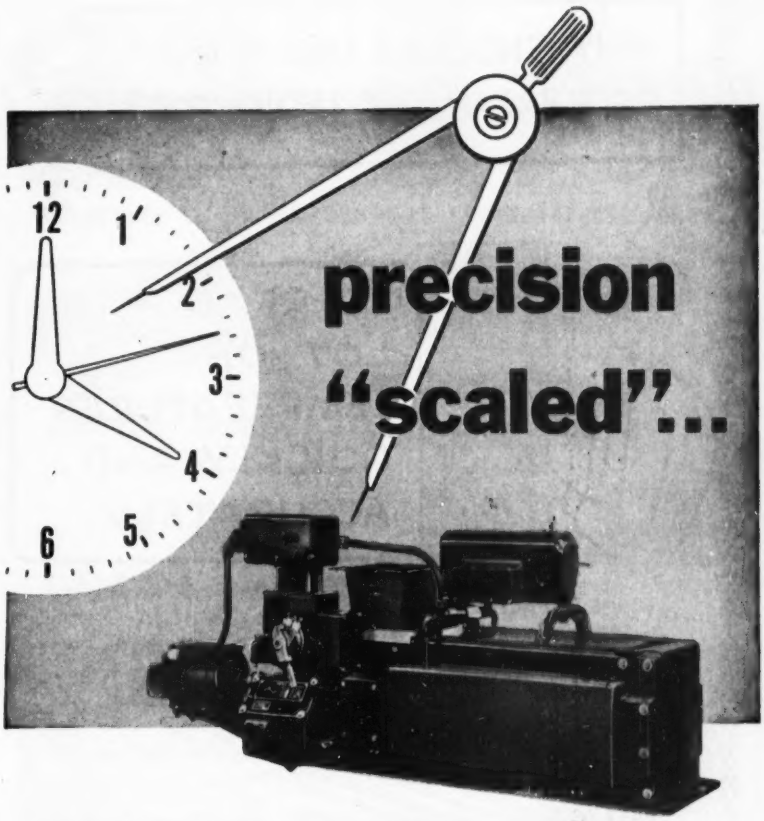
"Techniques[18] are normally represented[19] in this segment of the alphabet.[7]

"A number[20] of the discussions are about arts and sciences[21] which are of fringe interest to chemical engineers. These are, in some cases, extremely interesting reading.[22]

"Of major value are some of the articles in the largest[23] category—groups or families of compounds.[24] These are variable in length[25] as well as intrigue[26] and value[27] and humor.[28]

---

13. Five.
14. Silk, Soap, Steel, Shellac, Shale Oil.
15. "Price in February 1954 was $5.00 per pound."
16. "Many minor or trace elements have been detected [in shale oil] namely; Ag, As, Au, B, Be, Co, Cr, Cu, Hg, Ir, Li, Mn, Mo, Ni, P, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, V, and Zn."
17. Silkworm eggs are grayish cream color if fertile and white if infertile.
18. Sampling, Sedimentation, Size Measurement, Size Reduction, Size Separation, Solvent Recovery.
19. Section on Sampling is too long. Others are above average in interest and value to chemical engineers.
20. Only one this time:
21. Silvering.
22. Including recipes for deposition of platinum, copper, gold and other metals as well as for metallizing plastics. Also included: vacuum evaporation, vacuum sputtering, gas plating and flame spraying.
23. Thirty-three entries.
24. Salad Dressings, Salts, Seaweed Colloids, Selenium and compounds, Sequestering Agents, etc.
25. From 1 to 57½ pages.
26. "Cholesterol . . . is theoretically capable of existence in 256 racemic modifications."
27. Value depends on the user. The Encyclopedia will usually supply worthwhile help or guidance.
28. "Addition of 1-2% of powdered egg white, or even whole eggs, contributes nothing but expense to a commercial shampoo based on either soap or synthetic detergents."



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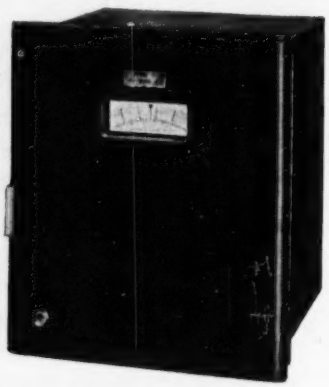


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Several hundred thermocouples or resistance bulbs can be connected to T-E's indicator through toggle switches, rotary switches, or connector panels. Switches are housed in a separate case identical to the indicator case. Capacity is 50 to 160 points. For less than 50 points a smaller case can be used, for over 160 points, 2 or more cases can be supplied.

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Large, 34" scale has from 400 to 600 widely spaced graduations for accurate and easy reading. Hairline is close to dial, minimizes errors from parallax.

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Full scale travel only 4 seconds. Balances rapidly at temperature value.



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From −320° to +200°F all the way up to 0° to 3000°F.

ACCURATE
±¼ of 1% of scale range.

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1/20 of 1% of scale range.

DURABLE
Simple design keeps maintenance low and instrument life long. Only 2 moving parts, the motor and the shaft carrying dial, slidewire, and drive gear. Slidewire is enclosed to protect it from dust or electrical interference.

Interested? Write for bulletin 61—E.

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SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
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BOOKSHELF . . .

"Single chemicals[29] are in the minority. But they are usually very well done.

"Theory[30] is adequately covered.[31] It is sometimes fascinating to discover facts outside one's own experience.[32]

"One entry[33] deserves special mention.

"Reading or thumbing through this latest volume, one discovers strange facts,[34] learns queer things,[35] is often amused[36] and is frequently impressed with the erudition[37] of the authors. Pedanticism[38] is, of course, at a minimum.

"It is a pleasure to recommend the series as a whole and this volume in particular.—LBP"

29. Two: Salicylic Acid, Salt.
30. Solvolysis, Stereochemistry (both organic and inorganic), Soil Chemistry.
31. In 2.8, 52.5 and 19.5 pages, respectively.
32. "Addition of copper effected a marked increase in the growth of sunflowers . . ."
33. Salts. It was written by Senior Editor Kirk who, in slightly less than two pages, discusses the nomenclature used with inorganic and organic salts and "salt-like" compounds.
34. "The number of these organisms [*Escherichia Coli*] voided per capita per day is estimated at 250 billion."
35. "It has been estimated that 17,000-90,000 insects are required to produce sufficient sticklac for 1 pound of shellac."
36. "There is a record of one man who drank 200 ml. of a liquid silicate. It caused severe internal upset, but was not fatal."
37. "Since the taxonomy of the seaplants is still in a state of flux, the botanical identifications except for the most commonly employed should be used cautiously."
38. "A duplicate sample is an additional and separate general sample drawn at the same time and from the same sampling unit as the original general sample."

Wide Audience

ORGANIC CHEMISTRY: A BRIEF COURSE. By Robert Ward Getchell. McGraw-Hill Book Co. New York. 278 pages. $4.

Reviewed by F. K. Kirchner

Designed for a one term (semester or quarter) course for students

for whom organic chemistry must be a service course, this book makes no attempt to develop the subject on the basis of electronic concepts and reaction mechanisms. However, through the use of the usual equations the author has given the characteristic reactions of the various types of organic compounds.

In order to insure adequate coverage of both aliphatic and aromatic compounds, the types of compounds in the two classes are treated either in the same chapter or in adjacent chapters whenever possible. A short chapter on heterocyclic compounds is included. Each chapter closes with a set of questions and a number of problems.

Since the book was written to reach as wide an audience as possible, sections on foodstuffs, plastics, synthetic fibers, medicinals, vitamins, enzymes, and hormones are included. The information in these chapters is brief, but up-to-date.

For a bird's-eye view of simplified organic chemistry and its applications this book seems to meet the need.

Absorption and Packing

TOWER PACKINGS AND PACKED TOWER DESIGN. 2nd Edition by Max Leva. The United States Stoneware Co., Akron, Ohio. 214 pages. $8.50.

Reviewed by T. R. Olive

Seldom does a book go into a second edition in less than three years. Here is a case where that has happened, however, for the first edition in 1951 brought a demand for more extensive treatment, while much additional information has since become available. Author Leva has therefore been persuaded to rewrite and greatly amplify his earlier work. The new edition is almost twice the size of the first and contains more than twice the quantity of data.

Although the sponsor and publisher of the book is a manufacturer of tower packings, the book is free of bias and thoroughly scientific in its approach. Arthur and publisher

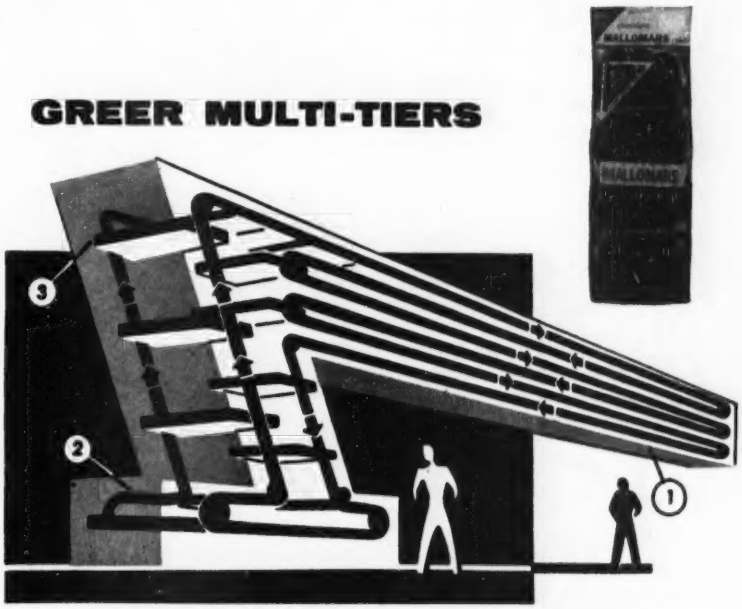


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New 8-page bulletin tells how a Multi-Tier will make your products best, for less. Write today.

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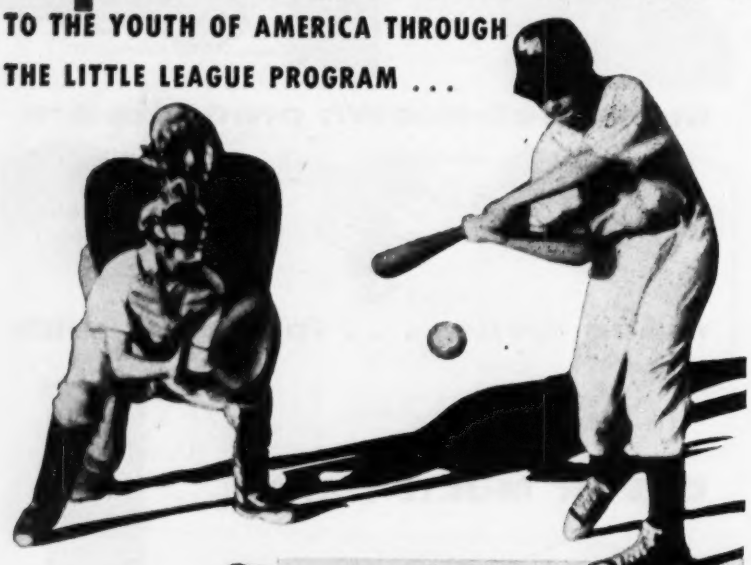
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THE BOYS WIN

Being part of the team, the pride of wearing the uniform, making a good play — these are all things each Little Leaguer enjoys at the moment, and will remember for the rest of his life. Regardless of the score at the end of the game, the boys all come out winners.

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Sparkler Manufacturing Co. sponsors this Little League team in Mundelein, Ill. Formed four years ago, there are fifteen boys on the team, and twenty games to be played during the summer. Sparkler wins in pride — pride of contributing to the happiness and growth of these Big Leaguers of the future.



SPARKLER MANUFACTURING CO.

MUNDELEIN, ILLINOIS

Canadian Factory, Galt, Ontario — European Factory, Amsterdam, Holland

For over a quarter of a century, engineers and manufacturers of a complete line of industrial filtration equipment.

are to be commended for the handsome appearance of the typography and illustrations, especially the many excellent charts and equipment details. To make certain that the reader will be able to use the design methods presented, Dr. Leva has included a good selection of worked-out problems in each of the sections.

About one-third of the book deals with the mechanics of packed tower operation, going into packings and their auxiliaries, pressure drop, liquid hold-up, and flooding. Other chapters cover mass transfer theory, generalization of capacity data, and absorption performance data for a sizable number of liquid-gas and liquid-liquid systems. An entirely new chapter treats distillation theory and practice in considerable detail. The bibliography has been much expanded and a glossary added. A concluding section discusses packed tower construction and gives a good assortment of pertinent engineering data.

Lueld

FIBER MICROSCOPY. By A. N. J. Heyn. Interscience Publishers, Inc., New York. 407 pages. $5.50.

Reviewed by Gerald Oster

This is essentially a handbook of microscopic techniques as applied to fibers. The book contains (1) a review of the morphological properties of the principal fibers—including synthetics, (2) a description of the handling and preparation of fibers for inspection in the microscope, and (3) a summary of the basic optics of the microscope and of birefringement materials.

The book is not intended to supplant treatises on these subjects but rather serves as a ready source of information for all workers in the fiber field who wish to identify fibers or to characterize the condition of some given fiber.

The author is at his best when dealing with cotton, a field of special interest to him. On the other hand, the reviewer found the discussion on wool quite inadequate.

There is no discussion of crimp of wool or of the chemical tests for the disulphite linkage.

The reviewer followed in the laboratory most of the experimental procedures presented and found that were well conceived.

The order of the earlier chapters is somewhat confusing in that there are chapters on the theory of microscopy indispersed with chapters on the description of fibers. However, the chapters on the polarizing microscope and its uses are presented in a proper arrangement. In the discussion on pp. 299-300, the author has not made clear his distinction between the method of central illumination and the Becke line method. The description of phase microscopy, on the other hand, is well done.

Despite these criticisms, the reviewer found this book to be an extremely lucid treatment of fiber microscopy and warmly recommends it to every worker in the field. The book is up to date and contains a number of useful references as well as plates of some synthetic and regenerated cellulose fibers.

Beyond the Decimal Point

MATERIALS AND PROCESSES. Second Edition. By James F. Young. John Wiley & Sons, New York. 1,074 pages. $8.50.

Reviewed by Charles L. Mantell

This is one of a series written in the interest of the General Electric Engineering Educational Programs. The author states that the emphasis "has been placed on presenting a broad study of engineering materials and manufacturing processes from the viewpoint of the engineer." "The subject matter has been organized to provide for textbook and reference use by students and practicing engineers, particularly those having product development, design, production, processing, quality, and application responsibilities."

The first two chapters on The Nature of Pure Metals and on Alloys are largely theoretical background. Metallographic Examina-

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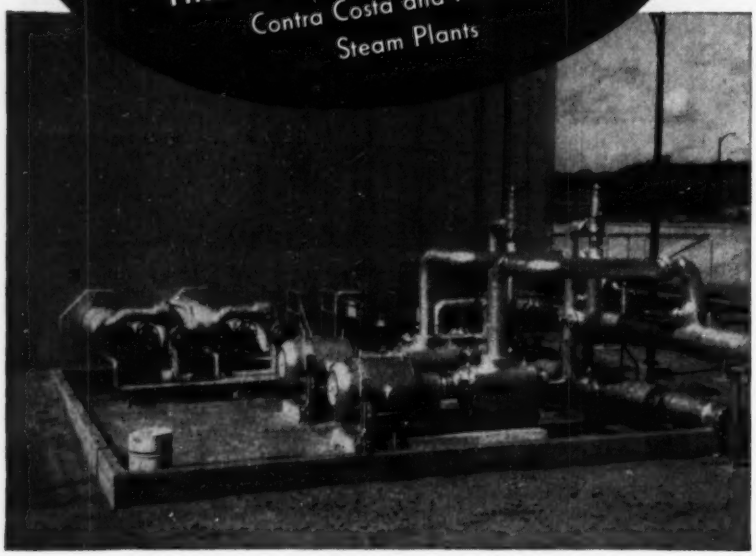
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Warren-Quimby No. 9 External Gear and Bearing Screw Pumps.
Photo, courtesy of: Pacific Gas & Electric Company

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BOOKSHELF . . .

tion is a generalized discussion with little emphasis on technique. Chapter 4 on the Mechanical Properties of Metals is well illustrated with line diagrams, and emphasizes the interpretation of tests without wearying the reader with details of the test procedures. Chapter 5 is the typical corrosion section, while Chapter 6 concerns itself with electrical and magnetic properties of metals.

Chapter 7 on Iron and Steel has considerable extractive metallurgy and process information, with less tabular data than might normally be expected. Chapter 8 covers the Nonferrous Metals and Alloys with some extractive metallurgy and relatively little physical metallurgy. Chapter 9 covers Nonmetallic Materials of both the inorganic and organic variety. Detail in each one of these, however, is sketchy. Electrical Insulation is the subject of Chapter 10, and this chapter is extensive. Plastics is the subject of Chapter 11, with emphasis not on classification of plastics but on design of molds for the formation of plastic parts. Chapter 12 is on Rubber, Chapter 13 on Ceramics, and Chapter 14 on Miscellaneous Nonmetallic Materials, including adhesives, resins, carbon, graphite, mortar, concrete covered in a little less than two pages, cork which is alloted the same space as concrete, and felt which is allotted more space than concrete, with leather, lubricants, and wood covered very briefly.

Part Two starts with chapter 15 dealing with Casting Processes. From here on the volume concerns itself with processes, and chapters are devoted to topics such as Powder Metallurgy, Heat Treating, Hot-Working Processes, Cold-Working Processes, Welding and Brazing. The welding chapter is one of the most extensive in the volume, covering more than a hundred pages. The remaining chapters are devoted to Machining; Cleaning, Plating, and Organic Finishing, again of the catch-all type without too much detail on any process; Gaging, Inspection, and Nondestructive Testing; with Statistical Methods.

The author has done a notable job in a difficult field. He himself appreciates that "A study of the broad field covered by this book requires, of necessity, considerable condensation to achieve the present compact size. It has, therefore, been necessary, on occasion, to sacrifice preciseness for clarity of presentation and practicality." The only question in the reviewer's mind is whether engineering materials can, considering the nicety of their use, have preciseness sacrificed. Today too much of our metallurgy is of the character "beyond the decimal point."

Manual

CHEMICAL METHODS IN INDUSTRIAL HYGIENE. By F. H. Goldman and M. B. Jacobs. Interscience Publishers, Inc., New York. 273 pages. $3.75.

Reviewed by J. J. Ferry

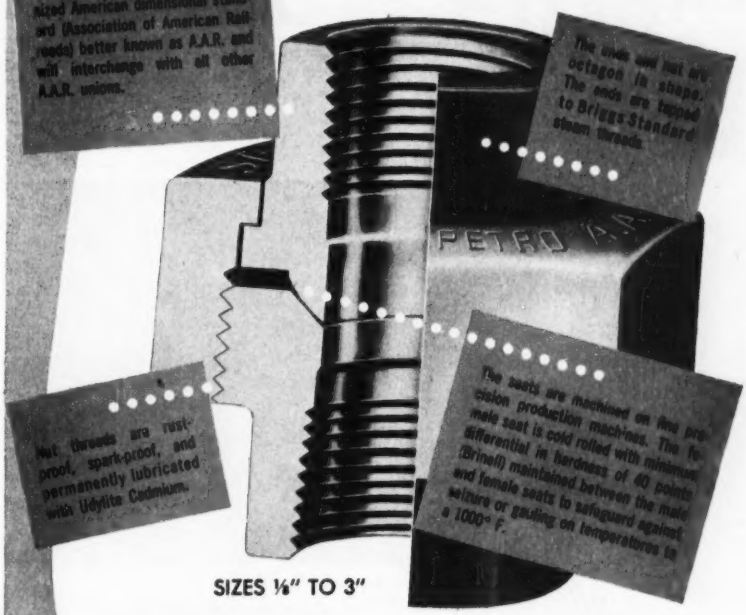
Essentially a laboratory manual, this book describes, step by step, the methods for analysis of most of the samples which might be encountered in industrial hygiene. As such, it is of particular value to the industrial hygiene chemist who wishes a quick review of the procedures involved and who has had sufficient experience to appreciate the pitfalls which may be involved in the seemingly straightforward analytical procedures. Less experienced individuals will find it advisable to review the references listed before undertaking the analyses. References are listed alphabetically at the end of the book, making them somewhat more difficult to locate than if the customary reference numbers in the text had been employed.

More detailed discussion of sampling methods would be desirable, including the use of filter paper and the numerous instruments for spot determinations. Chapter II on preparation of many of the reagents and standard solutions will be found to be a welcome part of the manual, saving time frequently lost in looking up this information.

The analytical methods selected have, for the most part, proved

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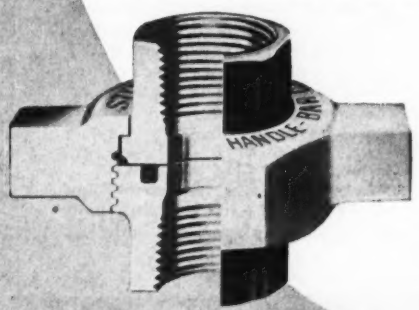
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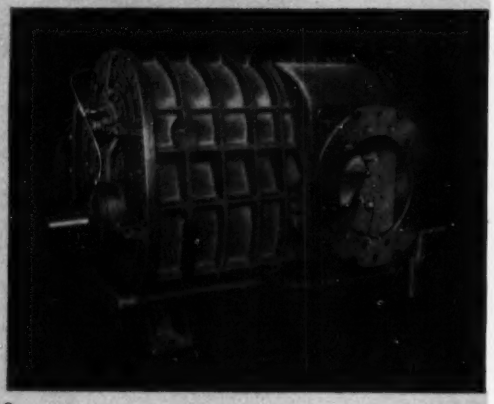
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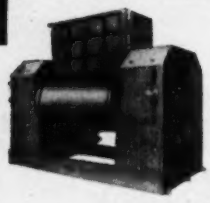
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their worth over years of use. In some cases, however, mention of alternate or newer methods would be valuable. Many analysts prefer the phosphoric acid method for quartz over the hydrofluorosillicic acid method discussed. Mention could be made also of White's phenophthalein method for hydrogen cyanide, the alkaline potassium iodide photometric method for ozone, Barne's method for mercury in air and Elkin's method for mercury in urine.

The method given for phosgene is not specific, depending on the presence of the chloride resulting from hydrolysis. Many other halogenated materials will interfere. More suitable would be the colorimetric method given in "Methods for Detection of Toxic Gases in Industry," issued by the Department of Scientific and Industrial Research, Great Britain. The chapters on solvents are particularly good, giving general information on the attack of a mixture of solvents, as well as detailed methods for determination of many individual materials.

It is felt that the subject matter under discussion includes too broad a field to cover properly in a manual. Space is necessarily too limited to permit adequate discussion of theory, reasons for taking the steps described, interfering substances and alternate methods. However, as a manual, this book should prove to be a useful addition to the library of analytical laboratories.

Plant Products

VEGETABLE FATS AND OILS. By E. W. Eckey. ACS Monograph #123, Reinhold Publishing Corp. New York. 836 pages. $16.50.

Reviewed by Gordon W. McBride

This book bears the same title as ACS Monograph #58, but it has a new author, a new arrangement, and approximately 60 per cent more pages.

Purpose of the book is to make "conveniently accessible the main facts about the chemistry of the

vegetable fats in general, as understood currently, together with reviews of the data and information available concerning each of the individual fats which has been investigated to any considerable extent". It is a monograph in the truest respect in that its content is comprehensive and critical, and limited to a particular subject.

Major change from the original monograph by Jamieson, which first appeared in 1932 and second edition in 1943, is the arrangement of subject matter. Botanic classification of the plant from which the fat is obtained governs in the new volume, regardless of the properties or uses of the fat. For those who are not familiar with the botany of these materials, a 46-page index will serve as a very helpful guide. Incidentally, this index is over three times the size of that in the predecessor volumes.

The first third of the book is devoted to a general discussion of vegetable fats, their chemical composition, physical and chemical properties, nutritional aspects, and methods of examination, analysis, and investigation. A short chapter also is devoted to genesis of fats and oils in plants, this being the contribution of Lawrence P. Miller of the Boyce Thompson Institute for Plant Research. Expansion of this chapter would be desirable in future editions of this monograph, if developments in plant science mature as expected.

Each chapter in the book closes with a generous list of references. Despite their large number, however, they represent only a selection concentrated from a very extensive bibliography potentially available. The author indicates that his selection was limited to those which he felt "the most reliable," recently published and readily accessible.

Although no section of the book is devoted exclusively to producing, processing and utilizing the vegetable fats, much of this material is included in the discussion of the individual fats and will be found also in the literature references. While a few chemical engineers may feel that such an omission is a serious one, the book will be of outstanding value in its presenta-

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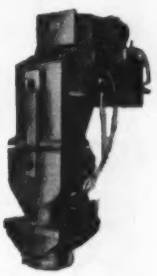
Thayer Automatic Filling Scale Model 600G



For holding, filling and checkweighing bags of powdered materials to tolerances within 2 oz. Feeder handles both highly flooding materials and those which flood only at times. Utilizes both gravity flow (plus compressed air or vibration when needed) and positive "dribble" feed. When proper weight is reached, feed gates close and checkweight lights indicate end of filling cycle. If weight is O.K., light flashes and filled bag is dropped or held for push button release.

Handles up to 6 bags per minute of unit weights ranging from 25 to 200 pounds. Also available as a net-weigher. *Write for Bulletin 600G.*

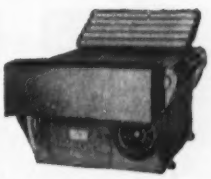
Thayer Fully-Automatic Filling Scale Model 400N



New fully-automatic scale for weighing and discharging loads for bagging or batchweighing. Dry materials in granular or pellet form are readily handled by unique feeding system that closely controls amount and rate of feed of any free-flowing material without pre-aerating or separating. Once speed and weighing controls are set, operation is completely automatic.

Handles weight units from 25 to 200 pounds at speeds up to 10 units per minute. Stainless steel feeding system. Also available as gross-weigher. *Write for Bulletin 400N.*

Thayer Checkweight Scale Model 200R

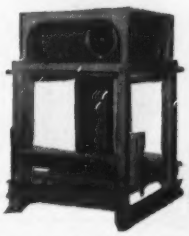


Automatically indicates weight of filled bags, drums and cartons. Offweight packages are separated from those properly filled by having the motor-driven, two-way conveyor deposit them at opposite ends of scale. Over- and under-weight tolerances are independently adjustable over a wide range.

Dial shows how much each package is offweight and horn sounds as each improperly filled package is discharged. Optional signal lights, remote dials, etc. available.

Model 200R handles up to 20 packages a minute with unit weights from 20 to 200 pounds. *Write for Bulletin 200R.*

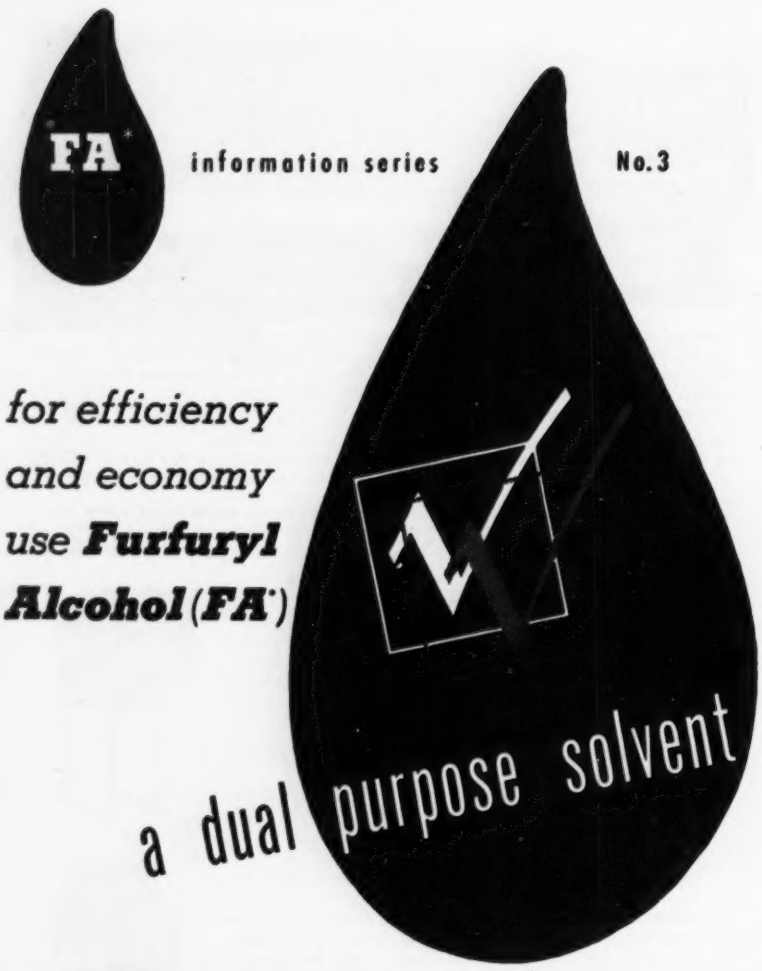
Thayer Checkweight Scale Model 200S

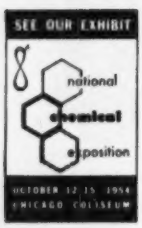


This Thayer scale has same performance specifications as Model 200R but has the conveyor platform belt only 10" above the floor. With the conveyor located beneath the scale, the spillage from broken bags will fall to the floor and not affect the weight of the bags which follow.

Like the Model 200R, this scale may be equipped with additional dial indicators for installation at remote control stations, colored lights which show whether the package on the conveyor is over- or under-weight, or a printing recorder which records the exact weight of each package. *Write for Bulletin 200S.*

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tion of the newest fundamental data on which engineering operations must be based.

Altogether, this is a worthy successor to the title "Vegetable Fats and Oils."

Laboratory Practice

EXPERIMENTAL INORGANIC CHEMISTRY. By R. E. Dodd and P. L. Robinson. Elsevier Press, Houston. 424 pages. $6.50.

Reviewed by J. A. Bishop

This book is divided into seven chapters as follows: General Basic Techniques; The Handling of Gases-Vacuum Technique; The Preparation and Purification of Gases and Volatile Compounds; Water, Alkalis, Acids, Solvents, Colloids and Disperse Systems; Physical Methods; Literature Presentation and Safety.

The subtitle of the book (a guide to laboratory practice), indicates the way it will be used in a very accurate fashion. There are numerous references to original papers at the end of each chapter, to which the user will have to refer for more explicit experimental details than are given in the text. A comparison of the chapters dealing with laboratory preparations to corresponding chapters in Blanchard, Phelan and Davis (Synthetic Inorganic Preparations) and with Inorganic Syntheses discloses that the directions in this new volume are in much less detail. As an example, the authors take about half a page for the preparation of $Ni(CO)_4$, to which Walton devotes three full pages.

The arrangement of material also differs from the earlier books. Excepting Walton (which is a text), they all stuck to the periodic system as a method for classifying, placing the compound prepared under the periodic group in which the main element in the compound would fall. The present volume divides the preparations into gases, liquids and acids, and colloids, the listing within each chapter differing with the chapter. Where a substance is available commercially,

the method of preparation is not given, but methods of purification are listed.

Differences are not necessarily detrimental. This book should serve to bring up to date the other books, and to be a valuable guide to men engaging in research in inorganic chemistry, which is what it is intended for. There are collections of pertinent physical data in each experimental section, "such as may be needed in the planning of experiments." The sections on techniques and methods of testing bring together in one volume information and cross references which will be of help to anyone interested in this field. It deserves a place on the shelf beside the others mentioned above.

Mellor, Jr.

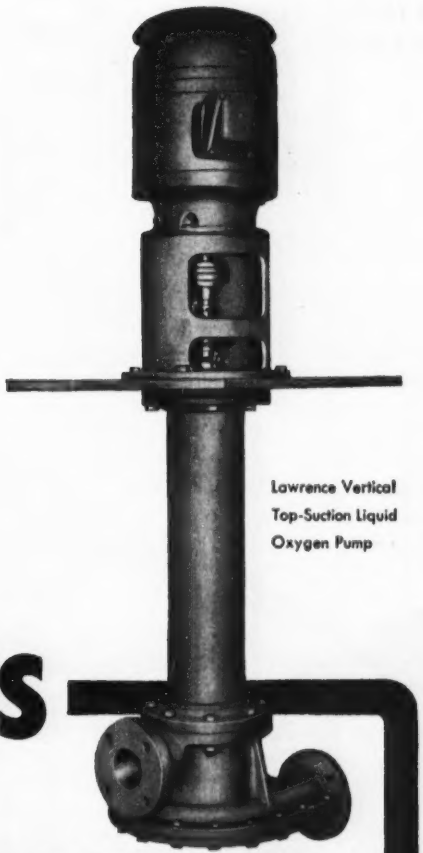
COMPREHENSIVE INORGANIC CHEMISTRY, VOL. I. Edited by M. C. Sneed, J. L. Maynard and R. C. Brasted. D. Van Nostrand Co., New York. 232 pages. $5.

Reviewed by Kenneth A. Kobe

For background material on inorganic chemicals or their reactions, the chemist and chemical engineer has been in the habit of turning to Mellor, "A Comprehensive Treatise on Inorganic and Theoretical Chemistry" that was published over the period 1922 to 1937. Here he found a literature survey with adequate references giving most of the statements in the literature concerning the particular chemical or reaction. It was "comprehensive" but not critically discerning.

If the searcher was not satisfied with the variety of statements of the prior art found in Mellor, he might continue on to Friend, "Textbook of Inorganic Chemistry" (1914-1937), another British set. Here he found not as many statements or references, but more of an understanding description of the compound or reaction. It did not read like a series of factual statements saying this and this and this.

Of course, if the searcher did want all of the facts, he could then



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back up Mellor with a study of the German set, "Gmelins Handbuch der Anorganischen Chemie," and if a new volume had appeared for the principal element in the compound, then a relatively complete literature survey had been made. All that remained was to interpret the incongruent statements in the light of modern facts and theory.

Drs. Sneed, Maynard and Brasted, all professors of inorganic chemistry at the University of Minnesota, have set about to produce an American series of books on inorganic chemistry that will be both comprehensive and discerning. A series of eleven small volumes will describe atomic and molecular structure and cover the periodic table. "It is comprehensive in the extensiveness of the fields covered rather than in the fullness of their treatment. Their purpose is to serve as a ready reference to those engaged in chemical manufacture and development and to those in advanced studies in chemistry in institutions of higher learning. Emphasis has been placed largely on chemical properties and relationships and their interpretation in terms of theoretical concepts of atomic and molecular structure, the deductions from the periodic system, and the basic ideas relating to electrolytes."

Vol. I lays the foundation in atomic and molecular structure and nuclear chemistry on which is based the later material describing groups of elements. Chapter I on the principles of atomic and molecular structure is by William N. Lipscomb, associate professor of physical chemistry at the University of Minnesota. Here are discussed electronic configuration, the various types of valence bonds that exist in molecules, applications of the principles of chemical binding to various kinds of molecules with unusual structures (water, ammonia, the boron hydrides, and the like), weak force fields around atom and molecules, and crystal structure. Chapter II on theoretical and applied nuclear chemistry is by Paul R. O'Connor, associate professor of inorganic chemistry at the Univer-

sity of Minnesota. He builds clearly and logically from the basic nuclear properties and particles to nuclear stability, spontaneous nuclear reactions and preparation of isotopes.

Chapter III on the actinide series by Glenn T. Seaborg, professor of chemistry at the University of California, is the first of the descriptive chapters. It will be an unfinished chapter for here Seaborg describes elements 89 to 98 while he continues to extend the series by synthesis.

Industrial research laboratories certainly will regard this set as essential for background material in inorganic chemistry. Because the volumes are sold singly, and are not expensive, specialists in certain fields will desire the volumes in their field. It is hoped that the volumes will appear at a sufficiently rapid rate so that the entire set will be available within a few years. The authors and editors are to be congratulated on the auspicious start of this series.

Materials of Construction

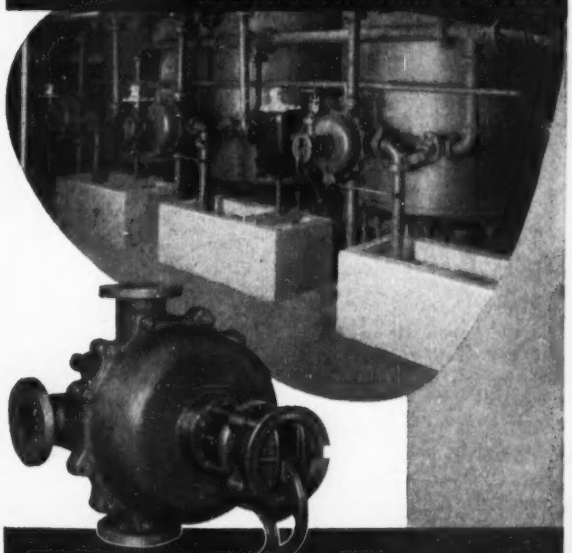
DIE METALLISCHEN WERKSTOFFE DES MASCHINENBAUES. By E. Bickel. Springer Verlag. 450 pages. DM 37.50 or $9.00.

Reviewed by Max Wulfinghoff

This work presents, in one volume, those parts of present specialized knowledge of physical and process metallurgy which are essential or indispensable to design and development engineers. It deals with the crystallography of metals, their atomic structure and cohesion, alloying, constitutional diagrams, effects of production operations and stressing upon metals, and quality control methods and equipment. In addition, specific data are given on both ferrous and non-ferrous materials.

The text is carefully organized, well written and profusely illustrated with diagrams and photomicrographs. Typography, general presentation and binding are all excellent. A valuable reference book for anybody active in the field who is able to read technical German.

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AquaMatic Solo Valves pressure-seat on long-wearing, resilient rubber . . . no metal-to-metal contact . . . no leakage from port to port. Lift-turn principle eliminates sticking, scoring, and wear . . . insures long valve life. With single lever control, Solo valve cannot be turned until lifted from seat. One multi-port Solo valve handles a complete regeneration cycle . . . built-in ejector and backwash controls are part of the valve.

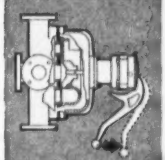
All pipe connections are made in backplate member . . . Solo valve can be dismantled, inspected, and serviced without removing pipe.

Tens of thousands of installations have proved the durability and reliability of AquaMatic Solo Valves. Investigate them TODAY.

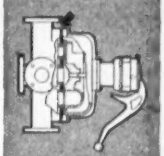
AVAILABLE IN 3/4 TO 4-INCH SIZES

Write for FREE Catalogs





HANDLE MUST BE RAISED TO INDEX SOLO VALVE—ELIMINATES . . . SCORING, STICKING, WEAR



VALVE SEATS ON SOFT RESILIENT RUBBER FOR LEAK-PROOF CLOSURES

AquaMatic and Solo Valves are trade-marks of AquaMatic, Inc., Rockford, Illinois

ENGINEERED WATER AquaMatic TREATING SPECIALTIES

AquaMatic INC. Formerly Automatic Pump & Softener Corp.
ROCKFORD • ILLINOIS



Barco Flexible STRUT* Joints

*For Structural Applications

—for Refinery TOWERS STACKS • LARGE PIPING

Barco Flexible Strut Joints are an important aid in *modern* refinery construction. A typical use is at the ends of struts for supporting or bracing large catalyst carrier lines or vent stacks on fluid catalytic crackers. In such cases, where horizontal lines require supports, two braces (with Barco Flexible Strut Joints in each) make costly "A" frames unnecessary. Other uses include the guying of tall vessels and columns and directing thermal movements of high temperature piping.

The Modern Way **to handle**

- **STRESS LOADS**
- **VIBRATION**
- **WIND SWAY**
- **THERMAL MOVEMENTS**

SIMPLE, VERSATILE!—The Barco Strut Joint is a dependable, compact, versatile fitting requiring practically no maintenance. It is a simple ball and socket that provides a point of flexibility in struts and guy rods. The close fit between the ball and the casing, allows for reversible loads, not possible with pin and clevis type braces. Barco Strut Joints support without restricting freedom of movement of piping.

COMPLETE LINE—Barco manufactures Strut Joints in the following sizes and load capacities: 1"—6,000 lbs., 1½"—8,000 lbs., 2"—12,000 lbs., 3"—20,000 lbs., 4"—50,000 lbs., 6"—130,000 lbs. Joints are made with welding ends for field or shop use. Unique "Bar-Moly" treatment of wearing parts provides a permanent dry lubrication for long service with little or no maintenance.

ENGINEERING SERVICE—Barco will be glad to work with your engineers in the selection of joints to meet your requirements. *Specifications and information on request.* BARCO MANUFACTURING CO., 516L Hough St., Barrington, Illinois.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS FOR CONVEYING FLUIDS

THIS MONTH'S

Recent Books

Adhesive Bonding

Directed to engineers and technicians interested in the practical aspects of adhesion. The author concerns himself with the synthetic resins and rubbery-type adhesives commonly employed in bonding of metals to themselves or to other materials. You'll find a chapter on industrial adhesives—with a list of trade names and manufacturers—a discussion of special high temperature adhesives, and a chapter on bonding techniques. 218 pages.

"Adhesive Bonding of Metals," by G. Epstein. Reinhold Publishing Corporation, 330 West 42nd St., New York 36, N. Y. $2.95.

Aid To Ion Exchanger Design

A handbook containing the complete numerical evaluation of the Thomas concentration history equation. This equation is important in ion exchanger design, and in heat transfer and absorption applications. There is also a discussion of basic equations in ion exchange, heat transfer and absorption; and methods used in computing the tables are explained. 111 pages.

"Tables for Predicting the Performance of Fixed Bed Ion Exchange and Similar Mass Transfer Processes." Public Relations Office, Stanford Research Institute, Stanford, Calif. No charge.

Heat Transfer

This is an attempt to bring together information on phases of fluid dynamics fundamental to an understanding of convection heat transfer. Fluid flow (laminar and turbulent) in various closed conduits, and around immersed shapes are discussed, together with the energy losses encountered. There are many equations and plots for predicting velocity profiles and energy losses. Also an analogy is used in

& Pamphlets

the last part of the booklet, between heat transfer and momentum transfer, to predict rates of heat transfer. 243 pages.

"Fluid Dynamics and Heat Transfer," by Knudsen and Katz. University of Michigan Press, 311 Maynard St., Ann Arbor, Mich. $3.50.

Student Counseling

A collection of papers delivered at a conference on counseling engineering and science students. This was held at the University of Minnesota in Nov. 1952. Papers were delivered by educational and industrial people. Some of the highlights—a paper on how to predict engineering grades; another on a counseling philosophy custom-built for engineers; a third on what industry looks for in an engineer. 88 pages.

"Selection and Counseling of Students in Engineering." University of Minnesota Press, Minneapolis 14, Minn. $1.75.

Aluminum Data

If you're looking for information on properties and characteristics of aluminum and aluminum alloys—you'll probably find it in this booklet. Forty-three different wrought aluminum mill products are defined and discussed—including fabrication methods. This is also done for casting alloys. There are 160 tables of data on aluminum—they include physical, chemical, mechanical properties; dimension tolerances and manufacturing limits (size and weight ranges) for various mill products. There is also a section on the new alloy designation system recently adopted by The Aluminum Association. 220 pages.

"The Aluminum Data Book," 1954 ed. Reynolds Metals Company, Desk PR, 2,500 South Third St., Louisville 1, Ky. No charge, but request on company letterhead.

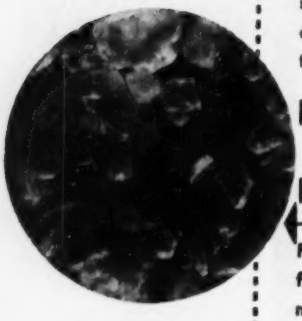


LUMPY CHEMICALS?

then try a PRATER POWER SCREENER



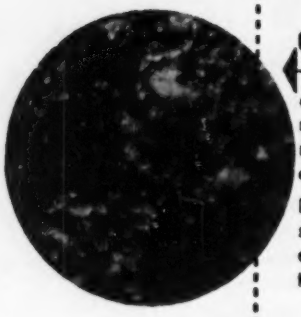
When crystalline or powdered chemicals become caked or agglomerated due to atmospheric conditions or pack down in shipment, it is necessary to restore them to their original form without grinding the crystals to dust. A Prater power screener is ideal for smoothing out such materials because its action is gentle enough to cause no grinding or attrition which would destroy the crystalline structure.



How do you want your raw chemicals?

like this . . .

Full size crystals practically free of floury dust and ready for mechanical mixing or solution.



or like this . . .

dusty fractured crystals — no longer resembling the original product, making dry mixing difficult and solution almost impossible.

Prater power screeners offer a good sound solution to this troublesome problem, and are used by processors throughout the world.

SAVE TIME!
SAVE LABOR!
INSURE UNIFORMITY!
MINIMIZE PARTICLE BREAKAGE!

The Choice of Chemical Engineers Everywhere!

PRATER

1517 So. 55th Court
Chicago 50, Ill.

THIS MONTH'S

Firms in

New Facilities



Kennecott Copper Corp. has opened its new $1¼ million research center, located on the campus of the University of Utah.

Gulf Oil Corp., Port Arthur, Texas has contracted with The Girdler Co. for the construction of a Girbotol gas purification plant.

Monsanto Chemicals Ltd. plans to erect plants in the Wrexham area England to manufacture materials for plastics.

Allied Chemical & Dye Corp. has begun construction on a $1 million addition to its Orange, Tex., nitrogen plant.

Westinghouse Electric Corp. has opened an Alabama electrode plant—the first of its kind in the South.

Atlas Powder Co. has reached the halfway mark in the construction of its $3 million home office building in Wilmington, Del.

Damascus Tube Co., Greenville, Pa. and Swan Eng. Co. have consolidated to provide expanded services to customers.

Acheson Colloids Co., Port Huron, Mich., has opened a Rochester, N. Y., sales headquarters.

Westvaco Mineral Products Div., Food Machinery & Chemical Corp. has acquired extensive deposits of high-grade phosphate rock in Rich County, Utah.

the News

M. A. Gibbons

New York Air Brake Co. has opened a combined sales office in New York to provide centralized services.

Allied Chemical & Dye Corp. plans to double the ammonia capacity of its Omaha, Neb., plant and to install facilities to produce various types of fertilizer solutions.

Shell Chemical Corp. has formed a specialized resins sales group to expand both surface coating and structural applications of Epon resins.

Monsanto Chemical Co. will build a new research center in Creve Coeur, Mo., for its Inorganic Chemicals Div.

Gulf Oil Corp. is reviewing bids for the construction of a $2 million warehouse to be built at its Port Arthur, Tex., refinery.

Petrocarbon Chemicals, Inc., Irving, Tex., will soon complete its $1 million plant for the production of synthetic organic chemicals.

E. I. duPont de Nemours & Co., Inc., plans to construct a research laboratory for its textile fibers dept.

Escambia Treating Co., Camilla, Ga., is expanding its wood preservation services to include pentachlorophenol.

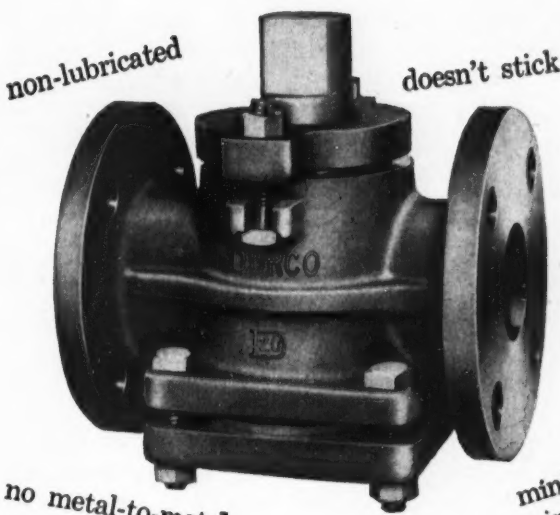
Oneida Paper Products' 5-acre plant in Centralia, Ill., is scheduled for completion at an early date.

Stone & Webster Eng. Corp. will plan and construct supporting facilities for Brookhaven Laboratory's new synchrotron.

Southern Calif. Air Pollution Foundation has signed a $37,850 contract with Midwest Re-

the valve for

66° Bé Sulfuric Acid service



DURCO type **F** valve

Available in sizes ¼" through 2".
Why not mail the coupon for full details?

The Duriron Company, Inc. Dept. CE
Dayton, Ohio

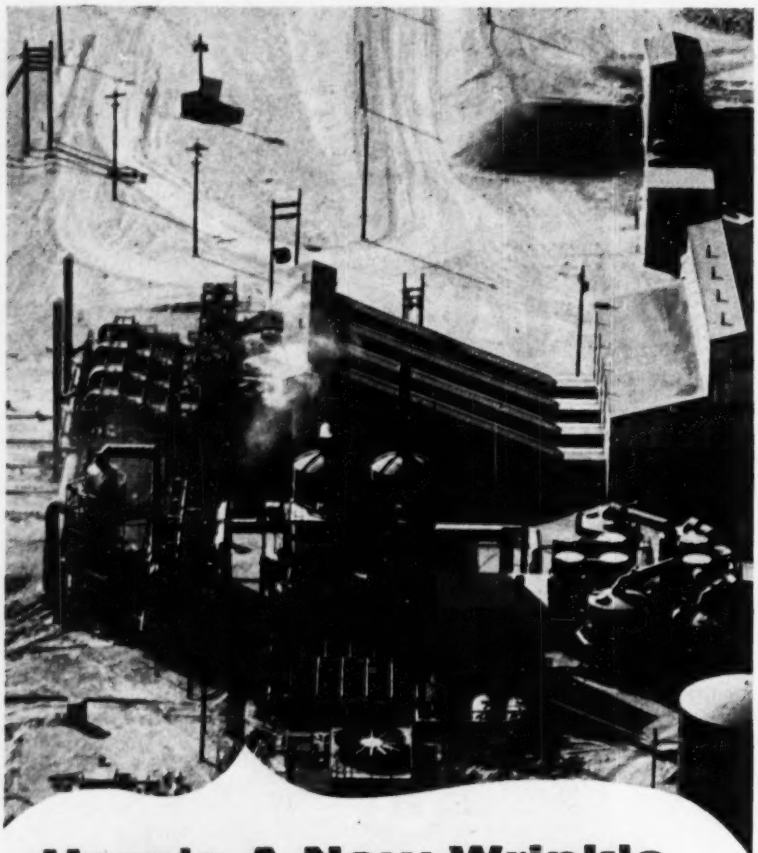
Please send details on Durco Type F Valve.

Name_____

Company_____

Address_____

City_____ State_____



Here's A New Wrinkle In The Sulfur Picture . . .

Leaching 11,000 tons of copper ore a day requires plenty of sulfuric acid. At Weed Heights, Nevada, Anaconda Copper Company is producing 450 tons of it daily . . . from a raw material previously considered useless! The material — low grade ore containing 25-30% elemental sulfur. The process — a Dorrco FluoSolids System which delivers 26,000 to 30,000 CFM of SO_2 gas to a contact acid plant. And the net result — a low grade and heretofore uneconomical source of sulfur has been made available for utilization on a world-wide basis.

If you have a problem involving fluidizing techniques, the separation of finely divided solids in suspension, or the use of ion-exchange, the chances are that Dorr and its Associated Companies throughout the world can be of service to you.

FluoSolids is a trademark of The Dorr Company, Reg. U. S. Pat. Off.

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Better tools TODAY to meet tomorrow's demand

DORR

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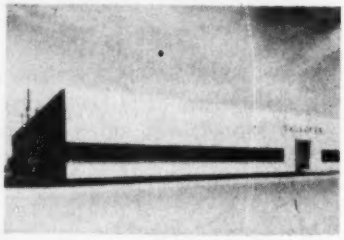
THE DORR COMPANY • ENGINEERS • STAMFORD, CONN.
Offices, Associated Companies or Representatives in principal cities of the world.

FIRMS . . .

search Institute for a study of the effect of automobile exhaust on smog.

Ekco Products Co., Chicago, has acquired Adams Plastic Co. of Holyoke, Mass., as a wholly owned subsidiary.

Reilly Tar & Chemical Corp. has opened a new Houston sales office in the Green Bldg.



Salkover Metal Processing of Illinois, Inc., Chicago, has moved to its new plant in Franklin Park, Ill.

La Gloria Oil & Gas Co. has purchased the assets of La Gloria Corp., Corpus Christi, Texas.

General Electric Co. is tooling for mass production of low cost high frequency transistors at its Syracuse, N. Y., facilities.

Nat'l Lead Co. has selected the Frederick Snare Corp. and Merritt-Chapman & Scott Corp. to expand its Nicaro, Cuba, nickel plant.

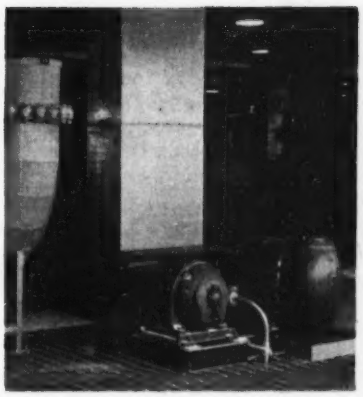
Reichhold Chemicals, Inc., will construct a phthalic anhydride plant near Montreal, Canada, at a cost of $750,000.

Standard Sulphur Co. has begun a $1½ million expansion program with the purchase of a second mobile sulphur plant in Texas.

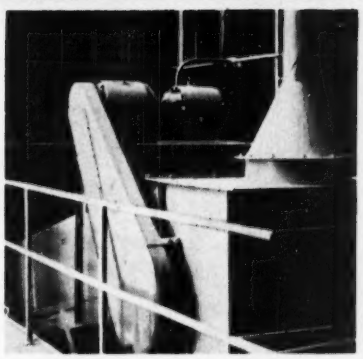
International Minerals & Chemical Corp. has acquired Sonsel Refractories Corp., Brighton, Mich., producer of zirconium refractories.

U. S. Steel Corp. has contracted with Wilputte Coke Oven Div.

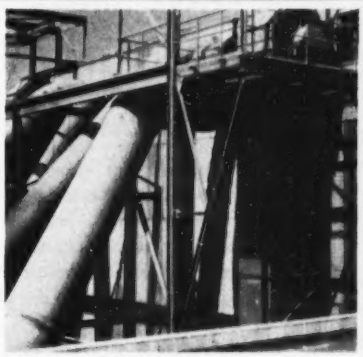
Efficient Fume and Dust Control...



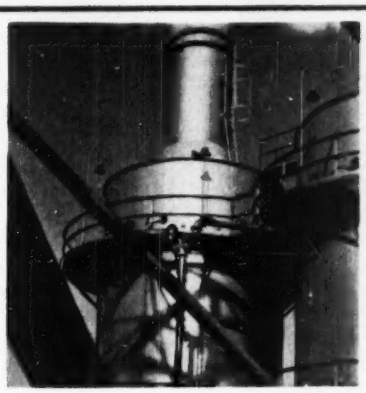
1. Raw rock and concentrated phosphoric acid are mixed to produce a fluid slurry . . . fumes are liberated here. Enclosed ducts carry off fumes from reaction agitators.



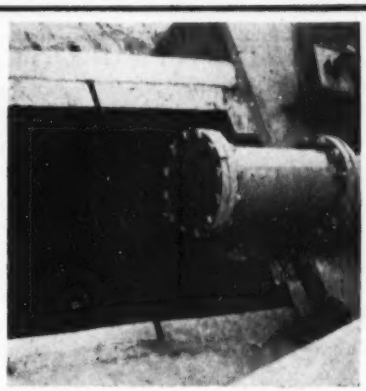
2. Slurry is dried in rotary drier. Totally enclosed conveyors carry material to screens. Dust duct carries off dust to dry cyclones.



3. Mixture of fumes and dust are led by sealed ducts to dry cyclones where recoverable solids are removed and sent back to process.



4. Cyclone overflow is carried through dust ducts to scrubbing towers for removal of fluorine fumes and precipitation of extremely fine solids. Clean gases are exhausted to atmosphere.



5. Scrubber water from towers is removed through sealed leg in order to maintain proper draft throughout dust control system.



Free flowing granules . . . important characteristic of concentrated chemical fertilizers produced by Dorr-designed plants.

Effective fume and dust control is as important in a well designed plant as every other phase of the process. And that's what you get with *every Dorr-designed* plant.

The illustrations above show how the problem was handled in the triple superphosphate section at the Davison Chemical Corporation's Bartow, Florida plant.

If you are considering a new plant . . . or expanding present facilities . . . it will pay you to check all the factors that make a Dorr-designed installation a modern and efficient chemical plant. Bulletin #8000, which gives the complete story, is available on request. Better still, why not talk to a Dorr engineer? There is no obligation of course.

Better tools TODAY to meet tomorrow's demand

DORR

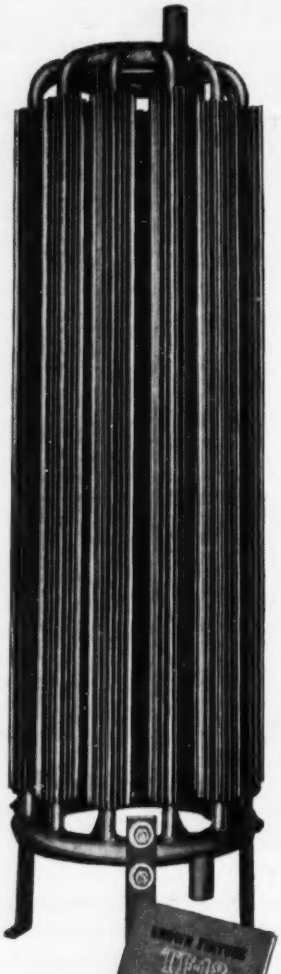
FIFTY YEARS 1904-1954

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

THE DORR COMPANY • ENGINEERS • STAMFORD, CONN.
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More tank heating for LESS MONEY!

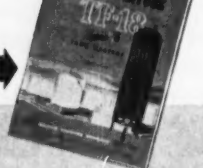
CUT YOUR TANK HEATING COSTS WITH BROWN FINTUBE TF-18 TANK HEATERS



● Users report that our vertically mounted TF-18 Tank Heaters cost less **including the installation** than just installing old fashioned bare pipe coils in the bottom of a tank. Also, the vertical mounting prevents sediment from settling on the heating surfaces as when the old fashioned coil is used. This means more efficient, less costly heating. It avoids heating through a layer of sediment and leaves the tank floor uncluttered and easy to clean.

The finned construction provides approximately 7 times more heating surface per foot of tube length than plain bare pipe or tubing. Consequently, TF-18 Heaters transfer **more heat**, faster and at lower temperatures, avoiding coking or damage to heat sensitive materials. Easily installed in existing or new tanks. They **do not** require welding inside the tank. Tried, reordered and widely used by the country's leading petroleum and chemical concerns.

Time is short. You'll need tank heaters soon. Act today. Get full details about these new, fully proved, less costly tank heaters.



New fully descriptive Bulletin No. 541 gives dimensions and full details. Write for your copy today.

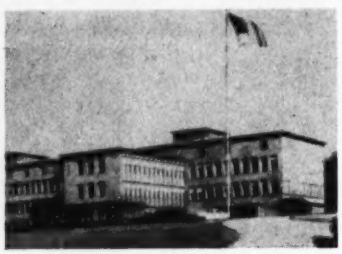
Brown Fintube Co. *Elyria, Ohio*

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CHICAGO • ST. PAUL • ST. LOUIS • KANSAS CITY • MEMPHIS • BIRMINGHAM • NEW ORLEANS
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BROWN FINTUBE (GREAT BRITAIN) LTD., BIRMINGHAM, ENGLAND
FRIEDRICH UHDE, GMBH, DORTMUND, GERMANY

FIRMS . . .

for the design and construction of three 64 oven batteries of Wilputte coke ovens for its Clairton Pa., works.

Army Ordnance Corp. has named a November starting date for operations at its $21 million "ball powder" plant—operated by Olin Industries, Inc., Illinois.



Westinghouse Electric Corp. has completed the erection of the steel framework for its new research laboratories.

Lithium Corp. of America, Inc., has acquired 100% interest in the Cat Lake, Manitoba, Canadian properties of Northern Chemicals, Ltd.

Atlantic Refining Co. is constructing a girbotol purification plant at Atreco, Texas. It was designed by the Girdler Co.

Tide Water Associated Oil Co., Inc., has placed new facilities on stream at its Avon, Calif., refinery.

Texas Eastern Transmission Corp. is contemplating reconverting a portion of the Little Inch pipeline to transport petroleum products.

Fluor Corp., of Canada, Ltd., Toronto, has opened a Calgary, Alberta, office in the Oil Exchange Bldg.

Illinois Institute of Technology will construct a wind tunnel designed for heat transfer studies just below the speed of sound.

E. I. duPont de Nemours & Co., Inc., has acquired an option on land in California for the future



Reflex type, internal tube model

get accurate level reading of hot or cold liquids

with Jerguson Heated and Cooled Gages

Here's your answer if you have the problem of getting accurate level readings of liquids that boil or surge or liquids that are heavy and don't flow at normal temperature. Jerguson Heated and Cooled Gages are specially designed and built to carry a cooling circulating medium to control boiling tendencies . . . or a heating circulating medium to speed the flow . . . so you get *accurate* readings. These gages are also ideal in cold weather applications for they can be heated to prevent gage freezing and breakage.

Jerguson's high standards of design are followed throughout; and materials are selected to exceed or conform to A.I.S.I., A.S.T.M. and/or A.P.I.-A.S.M.E. requirements. Available in external or internal tube models, reflex or transparent types, in a large number of sizes and pressure groups.

You'll get rid of the troublesome problems involved in steam tracing and won't have to insulate gages or valves, you'll eliminate the problem of getting accurate level readings of hot or cold liquids, and you'll cut maintenance hours and costs with Jerguson Heated and Cooled Gages. Send for detailed Data Unit and full information.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

100 Fellsway, Somerville 45, Mass.

Offices in Major Cities

Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

2 Important Booklets

1. on mineral acids



"Chemical Plant Control Data," a valuable handbook giving detailed methods of analysis, plus complete tables of property ranges and conversions for mineral acids and basic heavy chemicals.

2. on Alum

"Alum – Commercial Aluminum Sulfate," a highly interesting booklet bringing together information on the history, manufacture, properties and uses of this important heavy chemical.

For a copy of either – or both – booklets, please write on your company letterhead giving your title. And would you please tell us where you saw this ad?

As manufacturers of sulfuric, muriatic and nitric acids, Cyanamid is always ready to give service to customers concerning these products.

AMERICAN Cyanamid COMPANY

HEAVY CHEMICALS DEPARTMENT

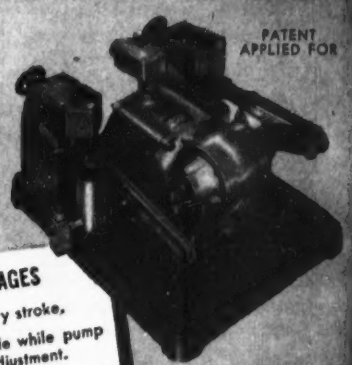
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

3 PUMPS IN ONE • 7,500, 15,000 or 30,000 psi working pressure made possible by the interchange of piston and cylinder assemblies in the same pump frame

MICRO-FLEX CHEMICAL PROPORTIONING PUMPS

Simplex and Duplex Styles



PATENT APPLIED FOR

CHECK THESE IMPORTANT ADVANTAGES

1. All liquid in the cylinder is displaced at every stroke.
2. Variable delivery—stroke readily adjustable while pump is running. Locking nut maintains stroke adjustment.
3. Stroke adjustment indicating scale is stationary and legible while pump is running.
4. Stainless steel piston and cylinder assemblies for 7,500, 15,000, and 30,000 psi working pressures are interchangeable in the same pump frame. Simplex and duplex styles.
5. Piston reciprocated by positive mechanical linkage to crank arm—does not rely on return spring.
6. Check valves removed easily for cleaning or replacement.

WRITE FOR BULLETIN 4061-A

AMINCO SUPERPRESSURE PRODUCTS

REACTION VESSELS
VALVES • FITTINGS
TUBING • PUMPS
COMPRESSORS
INSTRUMENTS
DEAD-WEIGHT GAGES
PILOT PLANTS

DESCRIBED IN CATALOG 45

AMINCO Superpressure Division

AMERICAN INSTRUMENT CO., INC.

Silver Spring, Maryland • In Metropolitan Washington, D. C.

get acquainted with the newest addition to

the WILLIAMS LINE of

COPPERAS TYPE PURE RED IRON OXIDES

OUR NEW 100 SERIES

--Available in 6 Shades ranging from
a Light Salmon Red to a Medium Maroon
R-2200, R-2900, R-3200, R-3800, R-4800, R-5800

Broad range of applications includes paints, rubber, building materials, leather finishes, plastics, paper, etc. Let our samples prove the value of these pigments. See your Williams representative or write us direct.

Compared with our other standard Copperas Reds, the "100" Series is
Brighter in color
Finer in particle size
Lower in oil absorption
Higher in purity
--at no increase in price!

WILLIAMS
COLORS & PIGMENTS
C. K. Williams & Co.

E. ST. LOUIS, ILL. • EASTON, PA. • EMERYVILLE, CAL.

FIRMS . . .

construction of a plant to produce tetraethyl lead and "Freon" refrigerants.

Avtane Refining Co. has awarded a contract for a 10,000 b/d refinery to be built at Freeport, Tex., to Tear Engineers, Dallas.

Visking Corp. has purchased the facilities of the Allen B. Wrisley Co. valued at $1.9 million.



Bemis Bros. Bag Co.'s new multiwall paper shipping sack manufacturing plant has started operations in Wilmington, Calif.

Food Machinery & Chemical Corp. has purchased the Chicago Pump Co., producer of sewage treatment and disposal equipment and specialty pumps for building services.

Porcelain Enamel Frit & Glaze Div., Ferro Corp., will install two continuous smelters at the Los Angeles plant.

Baker Perkins Inc. has acquired controlling interest in the Marco Co., Inc., Wilmington, Del., a firm engaged in research in the chemical process industries.

Crown Central Petroleum Corp. will soon complete construction of its new 5,500 b/d houdriformer, in Pasadena, Tex., built by Blaw-Knox Co.

General Electric Co., Waterford, N. Y., and Abbott Laboratories, No. Chicago, Ill., have completed a joint project making radioactive silicones available for industry.

U. S. Rubber Co. has selected Shreve, Lamb & Harmon Assoc.

STAINLESS
pipe fittings & fasteners
in STOCK

Complete line of pipe fittings, valves, plugs, bolts, screws, nuts, washers, keys, pins, studs and nails



- Over 9000 items in stock means *immediate delivery* from one source
- New Garden City plant now operating at *top speed and quality*
- Unsurpassed facilities for quantity fabrication of *specials*
- A staff of *seasoned* engineers always available for consultation
- *Pioneers* in the manufacture of stainless steel fasteners

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ALLMETAL
SCREW PRODUCTS COMPANY, INC.
GARDEN CITY NEW YORK

You gotta be first...
to be best!*



*25 years ago, Alloy Fabricators started to build Stainless Steel, Monel, Inconel, Nickel and Aluminum Process Equipment. With this experience, naturally, they're your *best bet today!*

It's Still Our Only Business — And We Mind It Well!

CCS ALLOY FABRICATORS
DIVISION OF CONTINENTAL COPPER AND STEEL INDUSTRIES, INC.
PERTH AMBOY, NEW JERSEY

NOW-Make Your Own Oxygen and Nitrogen in One Generator



...and Save Up to 50%!

With INDEPENDENT'S newly-designed generators, you can make your own high-purity oxygen and nitrogen from the free air . . . and in the same generator.

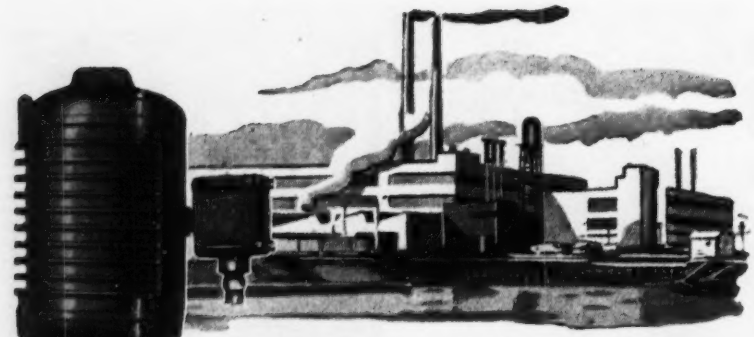
You reduce costs up to 50% by eliminating handling costs . . . vaporizing costs . . . evaporation losses . . . residual losses . . . and transportation costs.

INDEPENDENT Generators are available in any capacity, any purity and any pressure. Put your oxygen-nitrogen problem up to us . . . our engineering department will gladly submit recommendations . . . no obligation, of course!

INDEPENDENT ENG. CO., Inc.

CONSULTING · DESIGNING · RESEARCH

O'FALLON 7, ILLINOIS



Versatile
INDUSTRIAL SOLVENT PUMP
(FIGURE 4703)

Features of this unit extend its scope of applications from pumping gasoline and oil from underground tanks to pumping many kinds of industrial solvents and other liquids.

For hazardous conditions, this pump is furnished with a vertical solid shaft explosion proof motor. Standard open type motor is furnished for non-hazardous conditions.

Since the Turbine assembly is always submerged, the liquid is actually pushed through the system in a steady continuous flow. Pumps are self-venting and do not vapor lock. Priming difficulties are eliminated and instant delivery of gasoline assured, regardless of outdoor temperature conditions.

Other features of this efficient pumping unit merit your investigation. Capacities range from 15 to 75 g.p.m. for pressures up to 100 lbs. (depending upon capacity).

Write for complete details.

THE DEMING CO.
525 Broadway - Salem, Ohio

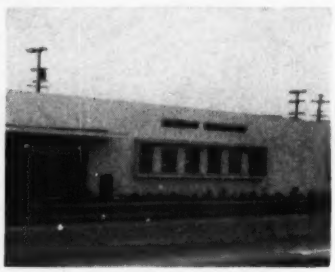
Specify **DEMING PUMPS**

FIRMS . . .

as architects for its $4 million research center to be built in Preakness, Wayne Township, N. J.

Heavy Chemicals Ltd., Madras, India, will build a plant for the production of caustic soda by electrolytic means, at Tuticorin, Switzerland.

Arthur D. Little, Inc. has opened the facilities of its Western Laboratories Div. (formerly **The** Merrill Co.) in San Francisco.



Amercoat Corp.—New executive offices and a laboratory have been set up in South Gate, Calif.

Cooper-Bessemer Corp. has formed a development div., technical div., and product div. at the Mt Vernon, Ohio, location.

Westlake Plastics Co., Lenni Mills, Pa., has purchased the plastics rod, sheet and tube business of Plax Corp., Hartford, **Conn.**

Standard Oil Co. (Indiana) will soon dedicate its new 30,000 b/d Mandan, N. D., refinery for processing Williston Basin crude oil.

Sunset Oil Co., Los Angeles has acquired Cook Oil Co., Phoenix, Ariz., through a 15-year lease.

International Paper Co., New York, has opened a new branch sales office in Cincinnati, Ohio.

British American Oil Co. Ltd. will soon install a catalytic reformer at its Calgary refinery.

Consolidated Chemical Industries, Inc., has broken ground at its

CONTROL OF PRODUCT PURITY

can be constant with MULTI-WASH

DUST, FUME AND VAPOR COLLECTOR

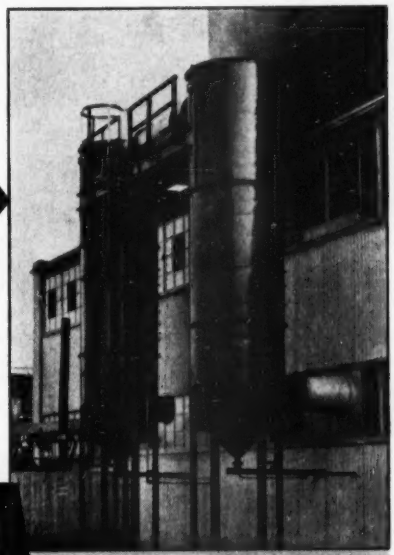
Processing of fine chemicals demands efficient control of air to keep contaminants out of the product and to maintain high quality and purity.

Effective dust control equipment prevents the contamination of one product from dust from other processes. Recirculation and reuse of water keep costs low.

Exacting product specifications are being met by the use of this twin Multi-Wash Collector installation shown at a leading pharmaceutical house.

Where the product is sublimed as one step in purification, the Multi-Wash Collector recovers valuable products that will pay for the installation many times over.

If you have a chemical dust, fume, vapor or odor problem be sure to call in a Schneible representative or call direct, collect.

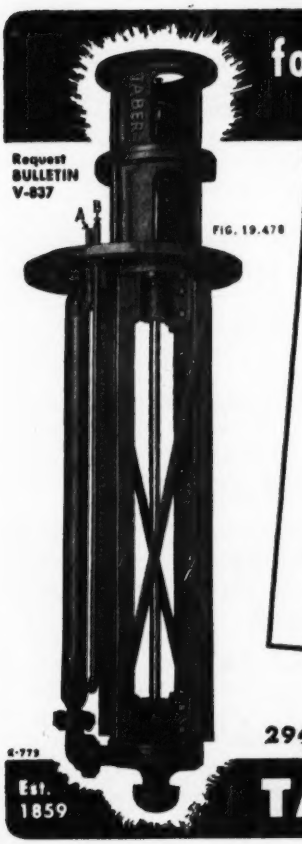


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SCHNEIBLE

CLAUDE B. SCHNEIBLE CO.
P. O. Box 81, North End Station
Detroit 2, Michigan

for Pumping SULPHUR



Request BULLETIN V-837

FIG. 19.478

This TABER centrifugal, Vertical Pump was designed to handle molten sulphur. Note the massive construction. Supporting the suspended pump from channel steel permits the use of an open shaft. This is especially desirable for molten sulphur.

Steam jacketed discharge pipe keeps molten materials from solidifying.

Pump operates efficiently at the relatively slow speed of 1750 r.p.m. (We consider 3600 r.p.m. prohibitive because molten sulphur has no lubricating properties.)

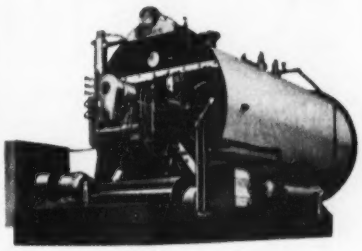
Write us the Head, and gpm you wish to handle together with the depth of your sulphur pit, and we shall send further information, with BULLETIN V-837.

TABER PUMP COMPANY
294 ELM STREET · BUFFALO 3, N. Y.

Est. 1859

TABER PUMPS

HOW SUPERIOR SOLVES YOUR STEAM PROBLEMS



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Completely factory-assembled and tested, a Superior Steam Generator is backed by undivided responsibility.

INDUCED DRAFT THAT'S BUILT-IN
. . . eliminates need of an expensive chimney . . . Multiple fans draw evenly on all tubes, reducing maintenance.

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High gas velocities produce high efficiency. Down-draft design promotes rapid evaporation, quicker steaming.

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A minimum of 5 sq. ft. of heating surface per boiler horsepower assures maximum efficiency at full rated capacity.

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Greater steam space and large evaporating surface provide ample reserve capacity & better than 99% dry steam.

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Built on a rigid channel iron base, a Superior Steam Generator needs only a floor capable of supporting its weight.

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All controls essential to completely automatic operation are factory-wired into an easily accessible control panel.

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Superior Burners burn oil or gas or a combination of both . . . changing from one fuel to the other in seconds.

18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 622-F. Water Tube types up to 40,000 lbs./hour write for Catalog 622-W.

for performance you can **BANK** *on*

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.



LEBANON STEEL Castings are at work

WORLD WAR II proved that pipelines are lifelines that protect every man, woman and child in this country. Counting the billions of barrels of oil that flow through these lines is the job of huge meters—meters like Rockwell Manufacturing Company's type 5PH Rotocycles. And in many of these Rotocycle meters Lebanon CIRCLE Ⓛ steel castings are used for the body base and covers.

Accounting for pipeline throughput is a tough, rigorous service for meters, involving such factors as high pressures (up to 1000 p.s.i.), pulsations, sudden surges and stresses induced by the pumps that keep the oil flowing.

Not all Lebanon castings actually protect life but *every* Lebanon engineered component works without fail because it is a product of men who give to their job the knowledge, interest and care of true craftsmen.

● See—STEEL WITH A THOUSAND QUALITIES—37-min., 16mm, semi-technical, full-color, sound film on the making of steel castings. For information write: Dept. F, Lebanon Steel Foundry.

LEBANON Castings
CARBON, LOW ALLOY
AND STAINLESS STEEL

FIRMS . . .

plant on the Houston Ship Channel for an alum liquor plant.

Sun Shipbuilding & Dry Dock Co. has opened an alloy products shop for the exclusive fabrication of stainless and alloy steel products.



Permatex Co., Inc., Brooklyn, has completed steel erection for its new chemical plant in Kansas City, Kansas.

Pan American Refining Corp. has completed its new high pressure laboratory for the study of chemical reactions.

General Electric Co., Chemical Materials Dept. has established a new experimental shell-molding foundry, in Pittsfield, Mass.

Bufnel Co., Ltd., has announced expansion plans for the manufacture of Bufnel steel-grid at its Hollydale, Calif., plant.

New Representatives

Automatic Methods, Inc., Elizabeth, N. J., has appointed the Detroit Tap & Tool Co. as its distributor in the Midwest.

Lewis-Shepard Products, Inc., has appointed Upton Bradeen & James Ltd. as representatives in Ontario, Canada.

Semet-Solvay Div. has appointed Wilson & Geo. Meyer & Co. as its coke sales agent in western U. S.

Clark Equipment Co. has appointed the George Industrial Equipment Co., Inc. as distributor for Greater New York.

Warwick Wax Co., Inc., has named The Shamrock Chemical Corp.,

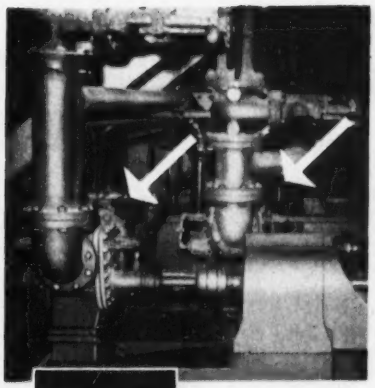


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SPRAY ENGINEERING CO.

115 CENTRAL STREET • SOMERVILLE 45, MASS.



BIG SUGAR MILL ...uses KINNEY pumps

Kinney Model SD Rotating Plunger Pumps handle 1st and 2nd molasses at giant Dominican sugar mill CENTRAL RIO HAINA—perhaps the largest mill in the Americas. Here's what they gain by using Kinney SD Pumps:

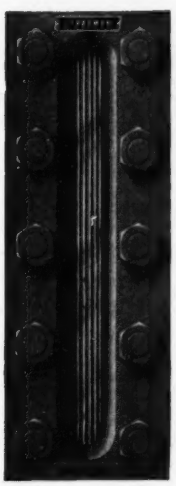
1. **Positive displacement pumping of meter-like dependability.**
2. **Low-maintenance operation insured by conservative rating of shafts, bearings, and other moving parts.**
3. **Efficient handling of viscous materials due to unique rotating plunger design.**
4. **The right pump for the job — insured by Kinney's wide range of models and sizes.**

Kinney Manufacturing Co.—manufacturers of liquid and vacuum pumps. Representatives throughout the United States and in foreign countries.

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.

Please send Bulletin L-51 describing the complete line of Kinney Liquid Pumps.

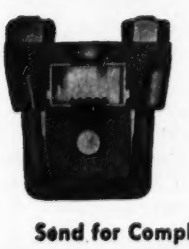
NAME .....
COMPANY .....
STREET .....
CITY ..... STATE .....



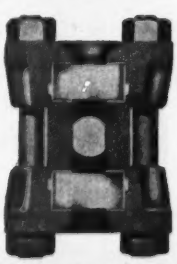
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LIQUID LEVEL GAUGES

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Standard Equipment in Leading Refineries and Industrial Plants All Over the World!



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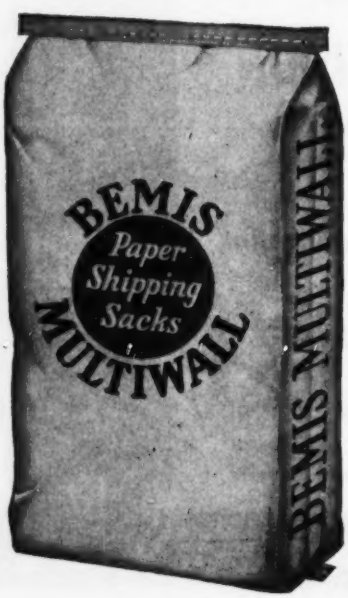
And you will know that Bemis color printing of brands on multiwall paper bags is bright, crisp, color-true . . . the kind that will boost the selling power of *your* brand.

Ask your Bemis Man to show you typical Bemis multiwall printing. Trust your own eyes.

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BEMIS BRO BAG COMPANY

General Offices—St. Louis 2, Mo.
Sales Offices in Principal Cities



FIRMS . . .

N. Y., as distributor in Delaware and Pennsylvania.

Pennsylvania Industrial Chemical Corp. has appointed Rice & Co. as its representative to the protective coating field.

New Locations

Sinclair Chemicals Inc. has moved its offices to the Sinclair Oil Bldg., 600 Fifth Avenue, New York, from 6 East 45 St.

Rogers Corp., producer of chemical and fiber specialty materials, has moved to Rogers, Conn. (formerly Goodyear, Conn.)

New Names

By-Chemical Products Co., manufacturer of waterproofing compounds and disinfectants, will now be known as E. A. Thompson Co., Inc.

American Potash & Chemical Corp. has adopted the trade name: V-Bor for its refined pentahydrate borax.

New Companies

Upson Chemical Corp. will produce and market various chemical compounds for the control of dimensional changes of cellulose fiber materials.

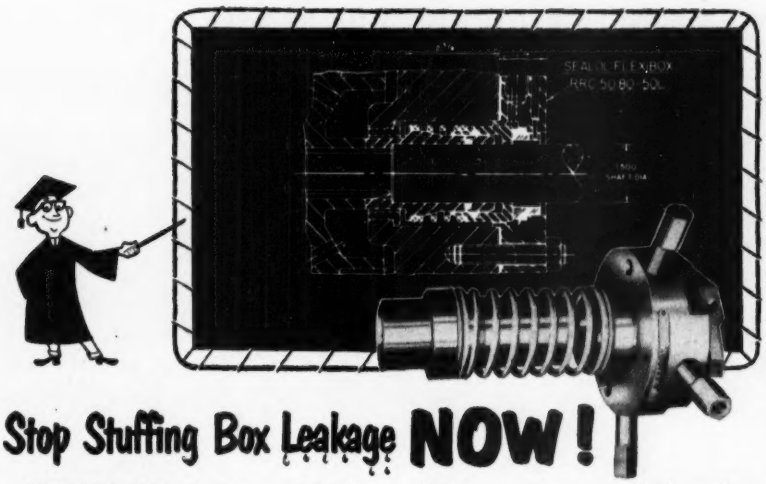
S & G Laboratories, Crosby, Tex., will manufacture devulcanizing agents for reclaiming rubber, emulsifiers and acids.

Control Products Co., Inc., Oakdale, Pa., will design and manufacture automatic control systems for the chemical industry.

Sulphur Exploration Co., Houston, Tex., will explore the Gulf Coast area for new deposits.

Orobis Ltd., jointly owned by the Distillers Co. Ltd. and Oronite Chemical Co., will produce a lubricating oil additive.

Pennsalt Chemicals of Canada has been organized in Hamilton, Ontario, as a subsidiary of Pennsylvania Salt Mfg. Co.



Stop Stuffing Box Leakage NOW!

HERE'S HOW. Bolt in a Sealol-Flexibox mechanical shaft seal in place of your conventional pump packing. Then watch this seal get rid of your pump maintenance problems. See how it eliminates gland leakage and shaft scoring . . . how it stops dangerous, wasteful loss of valuable product.

Write us about your shaft sealing problems. We'll be glad to send you details on Sealol-Flexibox designs for stuffing box replacement, for designed-in pump installations, or for special applications. Send for Bulletin 9 and complete details. Sealol Corporation, 11 Willard Ave., Providence 5, R. I.

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THERE ARE *Filpaco*
Stainless Steel TANKS For YOUR Processing
STANDARD · SPECIAL · ALL TYPES

Your inquiry will receive immediate attention.

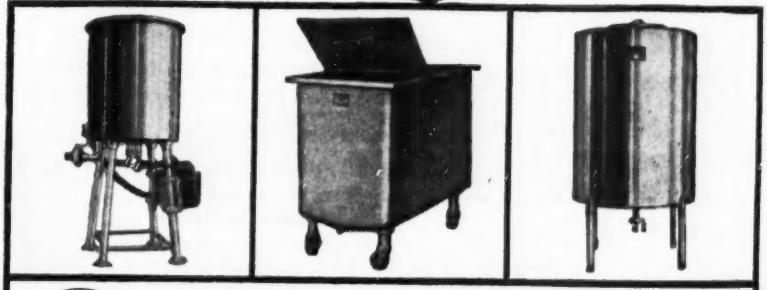
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Get the right tank . . . we maintain stock or fabricate to special designs for your particular need.

Any size . . . any capacity up to 3000 gallons. Horizontal, vertical, rectangular, with side, bottom or top entering agitators.

Also jacketed construction for heating or cooling; insulated.

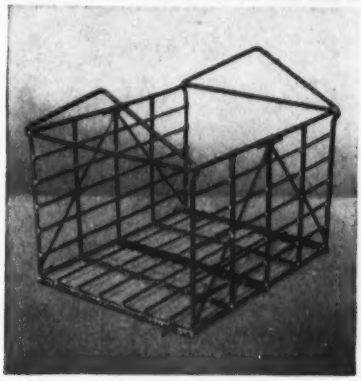
Accessories: level gauges, thermometers, special covers, special fittings, etc.



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Our Engineers treat your problem as an individual one. We can prepare specific designs to solve it or we will plan production to meet your own designs. Articulated or welded—we are prepared.

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Our shop facilities have simplified production and minimized the human error. We fabricate to prescribed methods.

Let us tell you about our welded and articulated structures. We work in all alloys, on any quantity. We're in the classified section of your telephone book, listed under "Baskets-Wire".

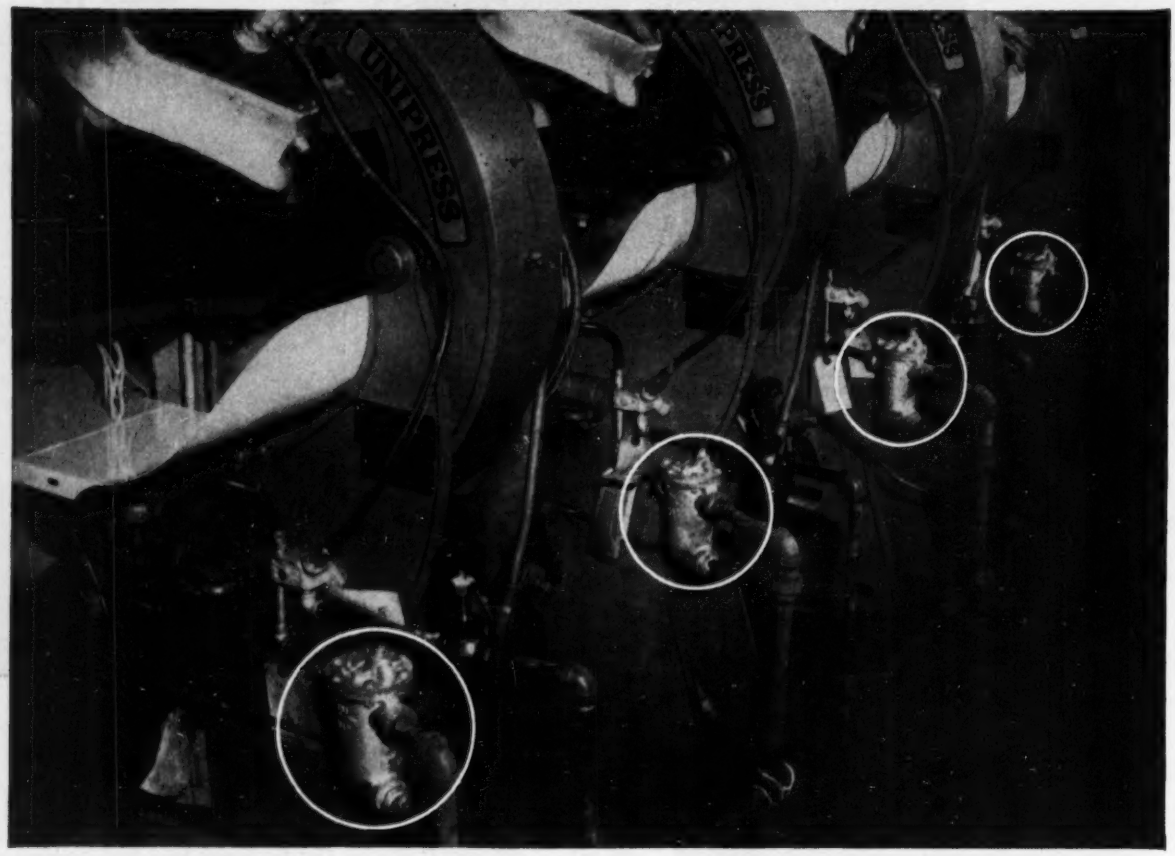
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You can't save money by skimping on Steam Traps—
An Armstrong Trap *on every unit* always pays dividends



Plant doubles production without appreciable increase in fuel costs



Built-in Strainer Traps save fittings, labor, maintenance. Cost less than separate trap and strainer. Complete data in literature mentioned below.

When Standard Coat, Apron & Linen Service took over a previous linen service plant in Portland, Maine, the boilers could hardly handle the steam load. Mr. Tom Foley, General Mgr. called Files Steam Specialty Company, Armstrong Trap Representative in New England, to help correct the condition.

Under supervision of Mr. Ken Raymond, Chief Engineer, Armstrong traps were installed on *each* unit in the plant.

Results: doubled production with no appreciable increase in fuel consumption; higher machine temperatures; boilers easily handle the load.

This is a typical example of the efficiencies and economies possible through Armstrong unit trapping. Could your plant stand a shot in the arm? Call your Armstrong Representative, or write:

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858 Maple Street, Three Rivers, Michigan

SEND FOR FREE CATALOG
—The "Steam Trap Book" contains 44 pages of trap data—selection, maintenance, trouble-shooting. Free on request. Or Consult Sweets or CEC.



ARMSTRONG STEAM TRAPS

IF YOU HANDLE FUMES CONTAINING

Sulphuric Acid — Sulphurous Acid — Carbolic Acid

Hydrobromic Acid — Hydrofluosilicic Acid — Hydrofluoric Acid

Phosphoric Acid — Pyroligneous Acid — Acetic Acid — Citric Acid

Chlorine — Oxalic Acid — Tartaric Acid — Formaldehyde

Nitric Acid — Zinc Sulphate — Ferrous Chloride — Caustic Potash

Ferrous Sulphate — Sodium Acid Sulphate — Sodium Hypochlorite

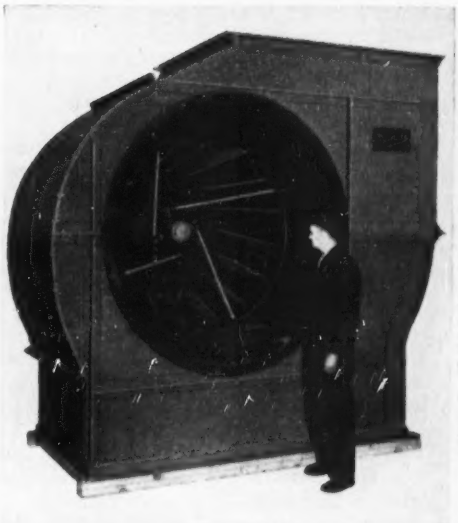
Copper Sulphate — Zinc Chloride — Bleach Liquor

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"Buffalo" RUBBER-LINED EXHAUSTERS Can Save You Real Money

Cost records in hundreds of plants show that "Buffalo" Rubber-Lined Exhausters last from three to twelve times longer than ordinary metal fans, handling the above fumes! Savings far more than pay for the cost of rubber lining, to say nothing of reduction of down-time. Rotor, shaft and inside of housing have a protective coating of rubber vulcanized on, effectively sealing off fumes from the metal. It's just one more example of how the "Q" Factor* saves you money when you specify Fans by "Buffalo". Write for Bulletin 2424-F for details.

** The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*



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VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Can You Use The "Grain That Stops Lightning"?

CRYSTOLON* silicon carbide (SiC), electrochemically produced from silica sand and coke, is produced by Norton in many forms. One of these forms, E-179 CRYSTOLON grain, is known as "lightning arrestor grain" because of its carefully controlled electrical properties — obtained by specially controlled furnacing techniques, which lower its surge impedance.

In Commercial Lightning Arrestors

E-179 CRYSTOLON grain has the particularly useful property of acting as an insulator at low voltages and as a conductor at high voltages. This "valving" action, analogous to pressure-controlled valves in a fluid system, is provided in the arrestor circuit by a spark gap in series with an E-179 grain unit, loose or molded into blocks. The number of series used varies according to the arrestor's voltage rating.

The non-linear behavior of E-179 CRYSTOLON grain may be expressed in terms of voltage and current by the equation:

$$V = AI^n$$

where A is a constant for a given sample, and n, the exponent, is approximately 0.1 for E-179. For a material where the exponent $n = 1$, the equation becomes Ohm's Law: $V = IR$. The value of A is controlled by the method of manufacture. The exponent is constant over a wide range of surge impedance.

Ceramic Non-Ohmic Resistors

in the form of block, disc or rod are composed of a fired mixture consisting principally of a ceramic bond and E-179 CRYSTOLON grain. The nature of this crystalline silicon carbide determines the finished characteristics of the resistors. Both the nominal grain size and actual distribution of grain size around the nominal are factors which must be controlled.

E-179 CRYSTOLON grain is available in grit sizes from 60 to 240, inclusive, manufactured to customers' specifications, with impedance values measured for every lot of grain in each grain size.

Besides the applications mentioned, other uses for this special CRYSTOLON grain are: spark plug resistors, railroad blocks and discs, voltage control devices and varistors for telephones.

Regular CRYSTOLON Grains

share the common characteristics of great mechanical strength and resistance to heat shock. And in refractory applications the high thermal conductivity of CRYSTOLON material — 8 to 10 times that of ordinary fireclay — is a distinct advantage.

CRYSTOLON silicon carbide dissociates without melting at the extreme temperature of 4170°F. It is an acid refractory and at elevated temperatures resists all slags except those high in alkalies. Other characteristics include: maximum operating temperature — 2800°F; specific gravity — 3.20; bulk density — 98 lbs. per cu. ft.; hardness (Knoop) — 2500; crystal structure — hexagonal system, hemahedral class. A typical chemical analysis shows:

SiC	98.13%
Free SiO_2	.50
Fe	.25
Al	.25
Free C	.20
CaO	.15
Si	.50
MgO	.02

Regular CRYSTOLON material is used for: metallurgical additions; as a source of silicon for silicon tetrachloride base silicones; for electrical heating elements; and for refractory cements and shapes for industrial furnaces which utilize its high thermal conductivity, high hot strength and good thermal shock resistance.

Other Norton Basic Materials

include ALUNDUM* fused alumina, MAGNORITE* fused magnesium oxide, NORBIDE* boron carbide, Fused Stabilized Zirconia and many others, including a number still undergoing research and development.

These high-melting materials which have varied applications in many fields, are also the basic ingredients of the famous Norton Refractory Rx's — refractories *engineered and prescribed* for the widest range of uses.

For Your Own Applications or Developments

Norton Company not only supplies these materials in their crude form, but has extensive facilities for processing and fabricating — and is ready to work with you in engineering materials to your particular requirements. A new booklet "Norton Refractory Grain — Electrochemically Refined" contains detailed information on these interesting materials. NORTON COMPANY, 509 New Bond Street, Worcester 6, Massachusetts.



E-179 CRYSTOLON grain, which insulates at low voltages, becomes a conductor at high voltages, thus providing "safety-valve" action in this lightning arrestor. Processed by Norton to develop unique electrical properties, this high-purity silicon carbide grain is finding an ever-widening field of usefulness.

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REFRACTORIES
Engineered... Rx... Prescribed
Making better products... to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

4

different types of TRI-CLOVER fittings used to solve specific Corrosion-Resistant piping problems for ELI LILLY & COMPANY

Eli Lilly's modern, efficient pharmaceutical plant at Indianapolis serves as an excellent example of the way in which some of the many types of Tri-Clover Stainless Steel Fittings are utilized to solve specific corrosion-resistant liquid conveying line problems.

With Tri-Clover and Eli Lilly engineers working together, the most efficient, economical type of fitting and line assembly was determined to meet each individual process requirement.

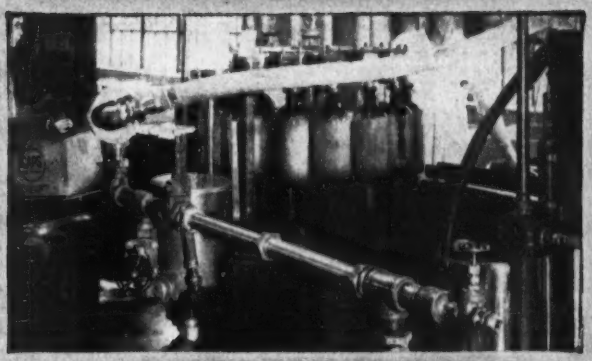
With a complete line of all types of highest quality stainless steel fittings, valves, pumps and tubing, plus experienced engineering service, Tri-Clover is extremely well qualified to help *you* solve your corrosion-resistant piping problems.

Call or write for further details.

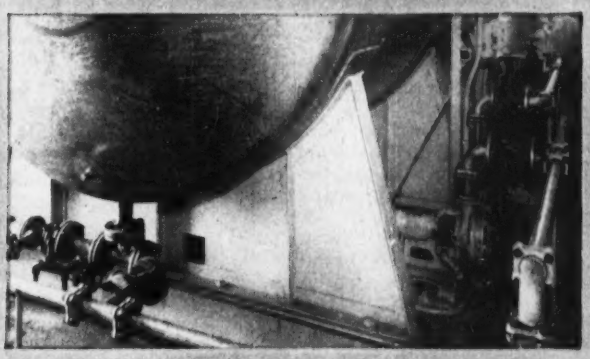
See your nearest
TRI-CLOVER DISTRIBUTOR

LADISH CO.
Tri-Clover Division
KENOSHA WISCONSIN

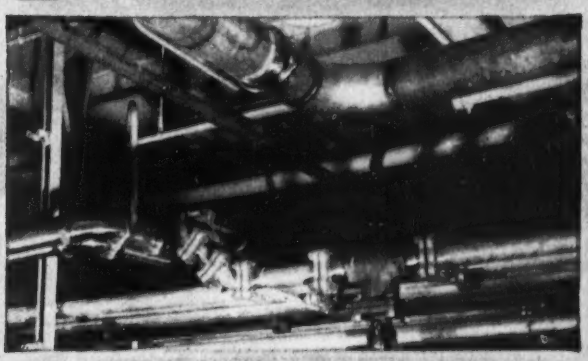
THE Complete LINE



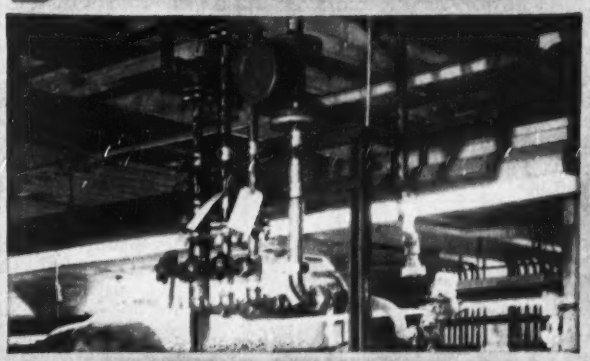
1 **Polished *sanitary type* stainless steel fittings are used here in liquid transfer lines to a filling machine.**



2 **Tri-Clover stainless steel *conical end* fittings are used here in processing Pyrogen-free distilled water.**



3 **View shows Tri-Clover *conical end, sanitary,* industrial welding and *Tri-Clamp* fittings utilized in several different liquid transfer lines.**



4 **Here are liquid conveying lines to filling machines, utilizing Tri-Clover *conical end, sanitary,* and I.P.S. screwed stainless steel fittings.**

835

EXPORT DEPARTMENT—8 So. Michigan Ave., Chicago 3, U.S.A.

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION
COPPER ALLOY BULLETIN
Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

How Temperature Affects Condenser Tube Corrosion Rate

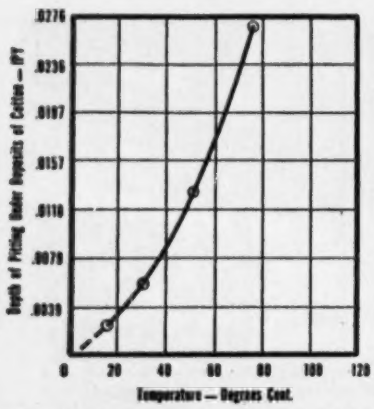
Heat speeds most chemical reactions—including condenser and heat exchanger tube corrosion. This is true on the cooling water side of condenser tubes as well as on the product side.

Tests on Admiralty Metal in 3% salt water solution showed that the pitting rate was eleven times greater at 75°C than at 18°C (see graph). Other tests have shown that the dezincification rate of Naval Brass and Muntz Metal in 2N sodium chloride solution goes up 6 and 11 times respectively when the temperature increases from 27° to 80°C. Red Brass doubles its corrosion rate over the same temperature range, while the rate for all three falls off to practically zero in contact with low temperature cooling brine.

Reasons for Hot Corrosion

Primarily, heat is energy which, when added to molecules, increases their activity and, as in the case of sodium chloride and hydrogen sulfide, their destructiveness. A temperature rise over a limited range in circulating water promotes organic activity and decomposition. This releases methane, hydrogen sulfide, ammonia and other sulfur and nitrogen compounds. Hydrogen sulfide will destroy a tube's protective film or patina of corrosion products and step up impingement corrosion, while ammonia may lead to stress corrosion cracking.

Air bubbles or debris clinging to the tube walls may set up local hot spots when stimulated by a higher temperature and rapidly produce corrosion pits. A high tube wall temperature may also promote penetration of the wall by intergranular corrosion which robs the tube of its mechanical strength.



Effect of temperature on corrosion rate of Admiralty Brass in 3% sodium chloride solution.

Corrective Measures

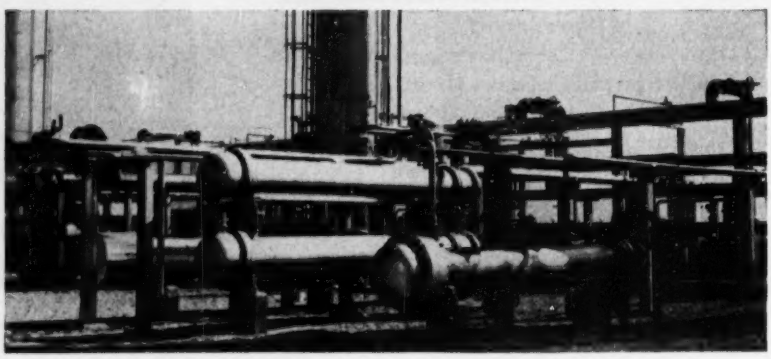
To offset high cooling water temperatures, the most effective remedies where applicable, are: (1) higher water velocities; (2) thorough tube cleaning; (3) chlorination to keep bio-activity down. The choice of tube alloy must be considered when strong chlorine is used, as strong chlorine solutions will severely attack copper and its alloys. The severity of attack will vary from one alloy to the next. When increasing water velocities, the properties of the alloy must also be considered. Arsenical Aluminum Brass, Arsenical Aluminum Bronze (Duronze IV) and the Cupro Nickel alloys are all recommended to withstand impingement corrosion at water velocities above 6 feet per second.

In general, low temperatures do not promote corrosion, although some media *are* corrosive at low temperatures. Refrigerants such as Freon and methyl chloride, and many beverages, chemicals, liquors or gases are good examples. Copper and its alloys have proved to be most satisfactory in low temperature operations—both in corrosion resistance and mechanical strength. These properties in many cases increase with lower temperatures.

Temperature has a marked effect on the corrosive activity of many media and can be instrumental in causing serious corrosion of condenser and heat exchanger tubes. For applications where temperature is a factor in corrosion, Bridgeport's Duplex Tubes offer hundreds of bi-metal, double-walled combinations to meet most double corrosive conditions.

One refinery, for example, used steel or red brass tubes for cooling propane gas containing an appreciable amount of hydrogen sulfide and some ammonia added to neutralize acidic constituents. It was found necessary to retube the heat exchangers every one or two years due to failure on the river water side. Replacement of the old tubes with a Duplex Tube of low-carbon steel lined with red brass resulted in an average life of 6 to 10 years.

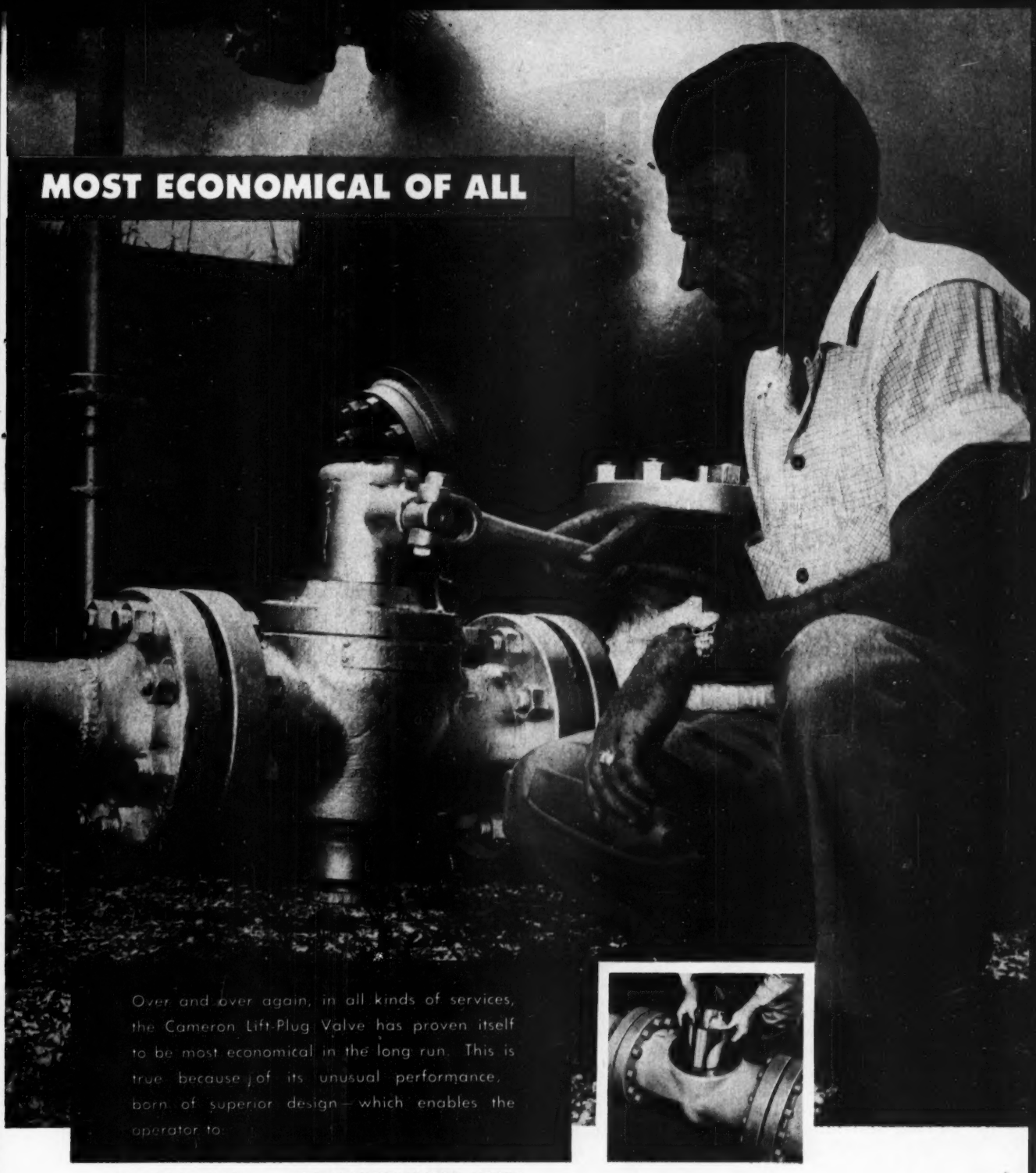
In other applications of coolers handling nitrogen compounds such as ammonia, monoethanolamine or organic cyanide, Duplex Tubes with stainless or low-carbon steel to the product side and copper or a copper alloy to the cooling water side, gave excellent results.



Use Bridgeport Technical Service To Solve Your Tube Corrosion Problems

The effect of temperature on tube corrosion is only one of the many factors involved in selecting the best tube alloy or combination of alloys for condenser and heat exchanger applications.

Bridgeport Technical Service with its wealth of experience in solving tube corrosion problems can help you get longer tube life and greater efficiency in your equipment. Call your nearest Bridgeport Sales Office for more information on this free service—and also ask for your copy of Bridgeport's Condenser and Heat Exchanger Tube Handbook. (1925)



MOST ECONOMICAL OF ALL

Over and over again, in all kinds of services, the Cameron Lift-Plug Valve has proven itself to be most economical in the long run. This is true because of its unusual performance, born of superior design—which enables the operator to:

- ACCOMPLISH MAJOR MAINTENANCE, WHEN FINALLY NECESSARY, WITHOUT REMOVING THE CAMERON LIFT-PLUG VALVE FROM THE LINE.
- RENEW THE CAMERON VALVE (WHERE OTHERS REQUIRE REPLACEMENT) SIMPLY BY CHANGING THE PLUG AND SEAT. Since the seat is separate from the valve body (see inset above), this operation can be accomplished in minutes.
- ELIMINATE COMPLETELY ROUTINE LUBRICATION EXPENSE AND INVENTORIES OF SPECIAL VALVE LUBRICANTS.

Cameron

NON-LUBRICATED LIFT-PLUG VALVES

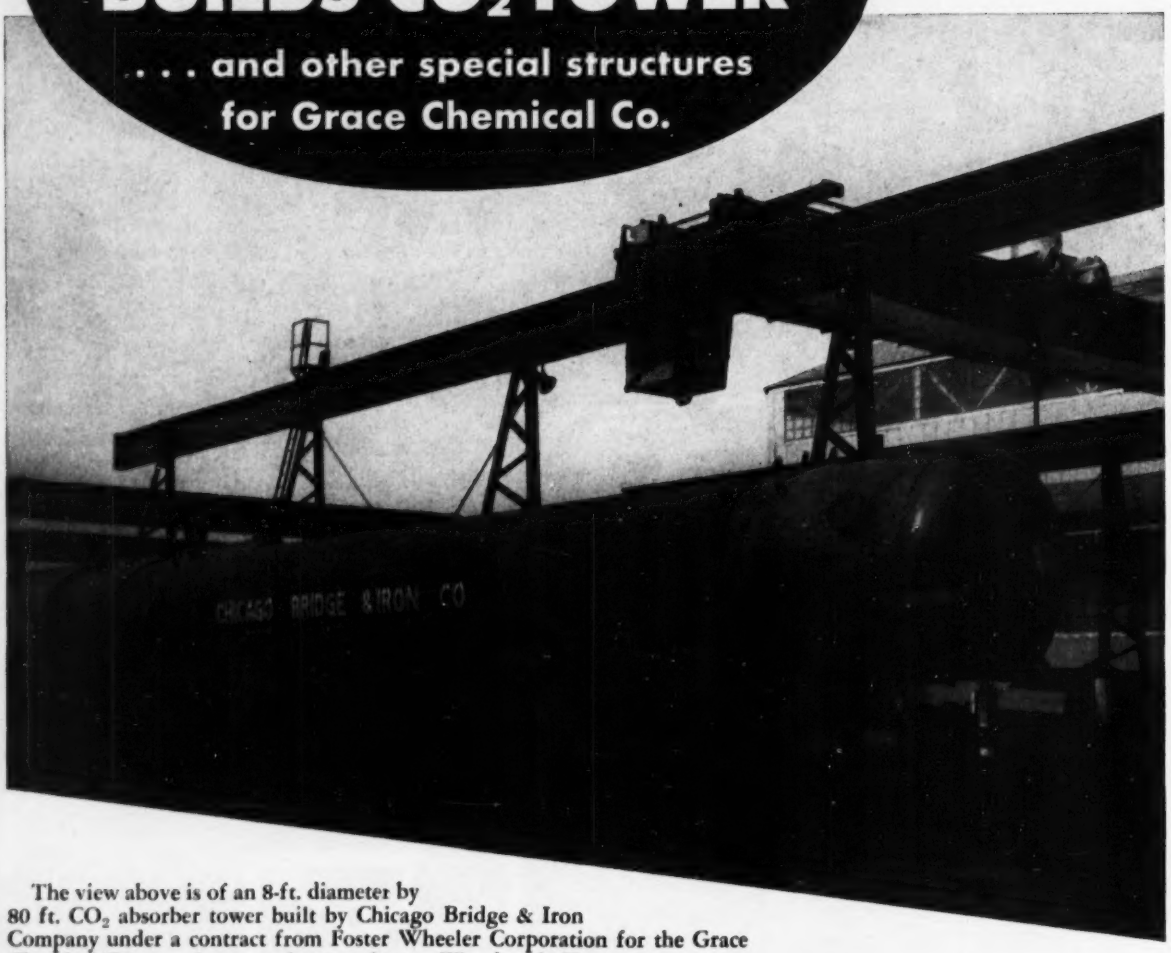
CAMERON IRON WORKS, INC.

VALVE AND OIL TOOL DIVISION

P. O. BOX 1212 • HOUSTON, TEXAS

BUILDS CO_2 TOWER

. . . and other special structures
for Grace Chemical Co.



The view above is of an 8-ft. diameter by 80 ft. CO_2 absorber tower built by Chicago Bridge & Iron Company under a contract from Foster Wheeler Corporation for the Grace Chemical Company's ammonia utca plant at Woodstock, Tennessee.

In addition to the absorber tower, Chicago Bridge & Iron Company also furnished the following structures for the plant: 10-ft. diam. by 12-ft. tank made of aluminum, 15,000-bbl. Hortonsphere®, 160-ft. diam. by 30-ft. ammonia tank, 35-ft. diam. by 30-ft. fuel oil tank, 20-ft. diam. by 18-ft. water tank, 15-ft. diam. by 24-ft. pump out tank.

The above structures are typical structures that Chicago Bridge & Iron Company is equipped to build for the chemical industry. We also build special tanks of solid clad, or lined corrosion-resistant metals. All four of our strategically located plants have equipment for X-raying stress relieving, completed and partially completed structures and pickling and painting fabricated steel plates.

Write our nearest office for information, estimates or quotations on any type of welded steel plate work structure to meet your needs.

CHICAGO BRIDGE & IRON COMPANY

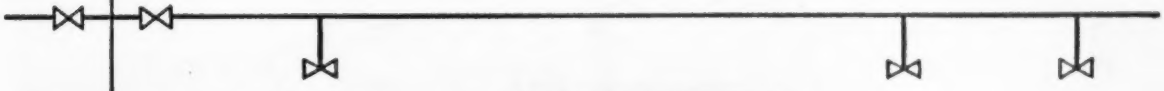
Atlanta 3.....2120 Healey Bldg
Birmingham 1.....1510 North Fiftieth St.
Boston 10.....1005-201 Devonshire St.
Chicago 4.....2124 McCormick Bldg.
Cleveland 15.....2220 Midland Bldg.
Detroit 26.....1503 Lafayette Bldg.
Houston 2.....2103 C & I Life Bldg.
Los Angeles 17..1505 General Petroleum Bldg.
New York 6.....3318—165 Broadway Bldg.
Philadelphia 3...1625—1700 Walnut St. Bldg.
Pittsburgh 19.....3205 Alcoa Bldg.
Salt Lake City 4.....505 West 17th South St.
San Francisco 4.....1522—200 Bush St.
Seattle 1.....1305 Henry Bldg.
Tulsa 3.....1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA



This "Hospital Valve" for OXYGEN now serves many industrial needs . . .

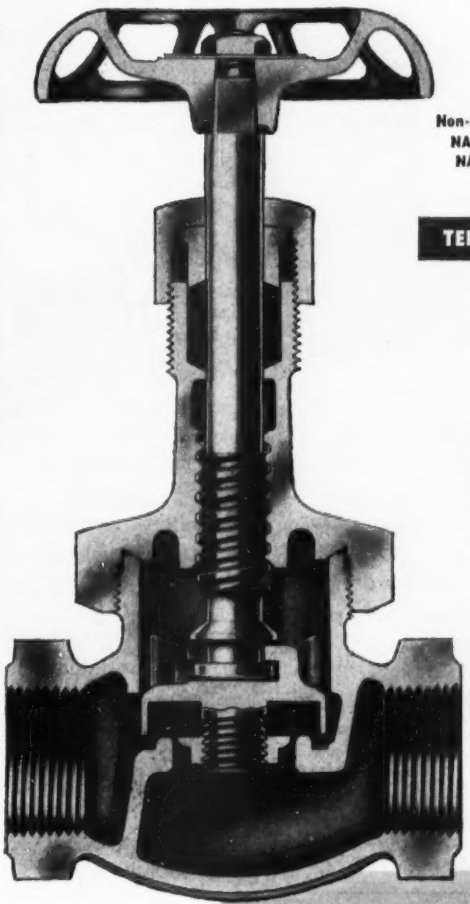
JENKINS Fig. 504 Bronze Globe with TEFLON disc and packing



Jenkins Fig. 504 was designed for the critical requirements of controlling oxygen, nitrous oxide, or any non-flammable gases in hospital services. Industry was quick to note its unique advantages, and it is now frequently specified for systems carrying gaseous fluids for heating, cooling, lighting, and processing, where pressure does not exceed 400 psi, or temperature a maximum of 150° F.

Fitted and tested to comply fully with all Association specifications for hospital services, Fig. 504 has the "extra value" construction throughout that is assured by Jenkins quality standards.

Get details — find out how Fig. 504 can improve efficiency and economy in your hookups for critical service. It's another example of the broad range of "valves for every service" in Jenkins' complete line.



Complies fully with "Standards for Non-Flammable Medical Gas Systems" of—
NATIONAL FIRE PROTECTION ASSOCIATION
NATIONAL BOARD OF FIRE UNDERWRITERS
AMERICAN HOSPITAL ASSOCIATION

TEFLON Disc and Packing

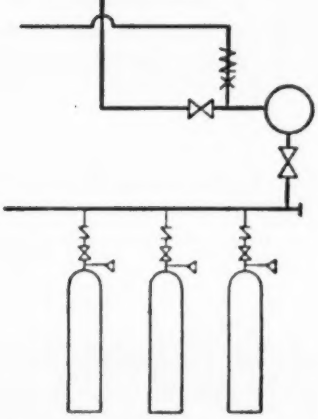
DuPont "Teflon" is a tough, "waxy" inert solid, gray-white in color, tasteless and odorless, non-adhesive and frictionless. Teflon's high resilience assures perfect contact of disc with lapped, crowned seat for gastight closure. Packing is one-piece ring of Teflon, provides dependable leak-proof seal with light compression.

Reinforced Body Casting
High strength bronze body is ribbed along bottom centerline providing extremely high factor of safety. Guards against distortion from vibration, shock, or pipe strains.

Degreased
All bronze parts are thoroughly degreased before assembly.

Polished Spindle
Alloy bronze spindle is polished to permit easy turning and assure leak-proof seal.

Sizes
— ¼" to 2" — 400 lb. O.W.G.



GET COMPLETE INFORMATION from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 116.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS EVERYWHERE

since 1920 / Glycerine is the Humectant

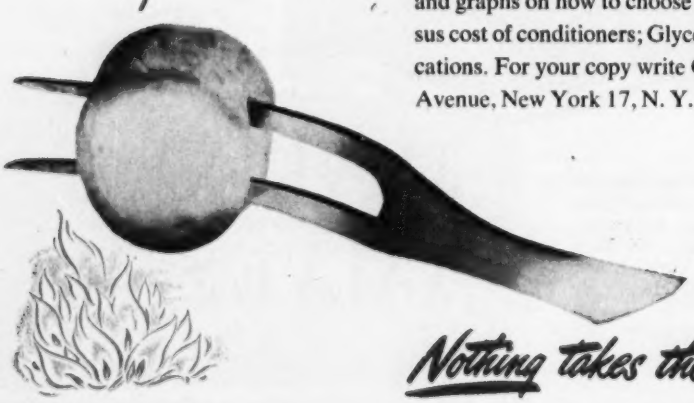
For over 30 years, "Fireside Kreamy Whip Marshmallows" have contained U. S. P. Glycerine. The Fireside Marshmallow Co. of Chicago uses Glycerine primarily because it preserves tenderness in cast marshmallows—keeps them fresh by retaining moisture.



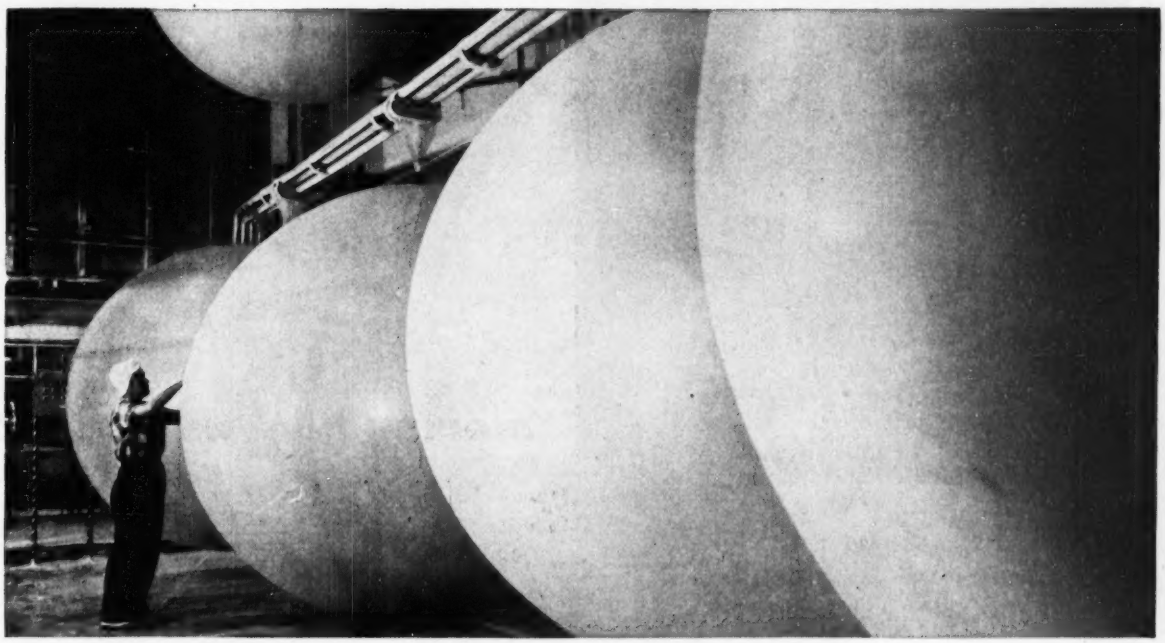
A conditioning agent used for foods, chewing gum, dentifrices, and pharmaceuticals must be desirable in taste. It also must *not* interfere with or distort other flavor elements. U. S. P. Glycerine fully meets these requirements.

In candies and confections . . . in flavoring preparations . . . in casings for meat and cheese . . . in dozens of other food applications—Glycerine's unique range of properties and freedom from toxicity make it an outstanding favorite.

NEW FREE BOOKLET ON PRODUCT CONDITIONING contains text, tables, and graphs on how to choose a product-conditioning agent; performance versus cost of conditioners; Glycerine properties, derivatives, grades, and specifications. For your copy write Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y.



Nothing takes the place of Glycerine



WEATHER BALLOON MAKER SAVES $2500 A YEAR WITH KATHABAR EQUIPMENT

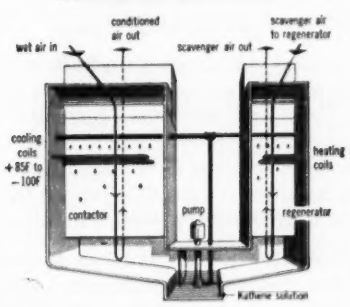
Kathabar humidity conditioning provides the right weather for making weather balloons. The Dewey and Almy Chemical Company obtains 40-grain air without frost, expensive over-cooling and re-heating, or duplicate coils. The system's coolant is 75°F water. *Results:* annual saving of $2500 in operating costs—and faster production of their balloons.

Here's how their two-zone system works. In the first zone, ground level, latex balloon gels are inflated from one-fourth to full size. Moisture between latex particles is a necessary lubricant during gel inflation. The maintained air conditions average 70°F, 50% RH.

Second zone, an 80-foot drying tower, is held at 100°F and 20-30% RH for final drying. The moisture must be removed at a controlled rate—not too fast or the balloons rupture; not too slow or production is impeded. Temperatures over 100°F would cause a spotty pre-cure.

This is a typical example of how Kathabar humidity conditioning has solved industrial air conditioning problems for 20 years. Your Kathabar system representative can show you how to dictate *your* production weather. As a trial balloon, write for Literature Group K54-2.

WHAT COULD BE SIMPLER?

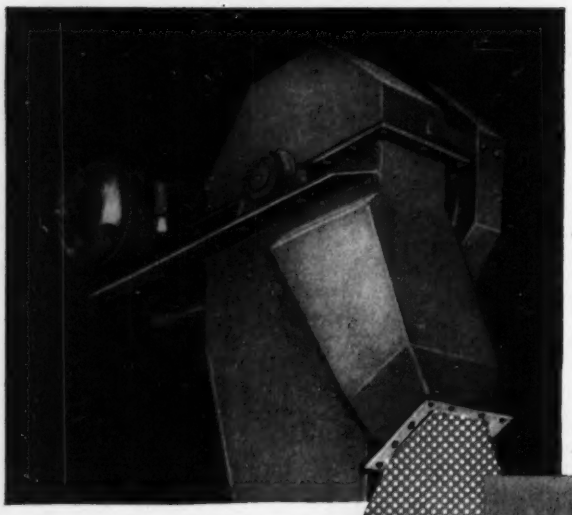


Air to be conditioned passes through the contactor, where an absorbent solution removes moisture (the amount depends on the automatically-controlled temperature of the solution). In the automatic regeneration, about 15% of the solution is heated, and the moisture it releases is blown out the window.

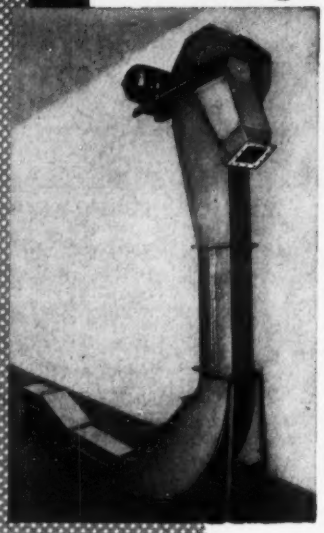
Kathabar®
HUMIDITY CONDITIONING

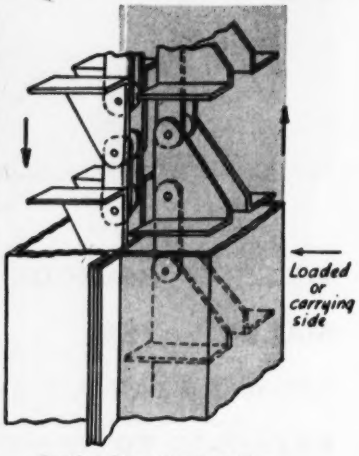
SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

ALSO MAKERS OF *Surface* INDUSTRIAL FURNACES *Janitrol* AUTOMATIC SPACE HEATING



moving bulk material?





Section Thru Vertical Run

move it Faster with a G-W FLOWMASTER

Feeding, conveying, and elevating are all taken in stride by this versatile G-W Flowmaster. It moves a variety of bulk materials in horizontal, vertical, or inclined planes—or in any combination—faster, more efficiently, and more economically. This *one* does the job of three!

A series of solid steel flights on an endless chain moves the bulk material in a continuous stream through a totally enclosed, dust-tight (or gas-tight) closely-fitted casing. The Flowmaster is self-loading and self-discharging and is designed for either continuous or intermittent operation. It's another versatile result of G-W's 139 years of progress in *engineered* materials handling . . . a policy proved by reports of increased efficiency and economy from all phases of industry.

Want to know more about the G-W Flowmaster? We'll gladly send a data sheet and full information on availability, prices, and special construction. Write today.

When you think of **ENGINEERED** *materials handling . . .*
think of **GIFFORD-WOOD**

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Since 1814
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Tri-Sure® Closures protect the purity and quality of STAUFFER CHEMICALS

IN industry and agriculture, the name Stauffer signifies uniformity and top quality in chemicals. And to safeguard this quality—in drum shipments from many of their 38 plants throughout the country—the Stauffer Chemical Company insists on *proved* methods of *protection in transit.*

As a result, drum shipments from Stauffer plants are protected by Tri-Sure* Closures—Tri-Sure Coated Flanges and Plugs for chemicals shipped in coated drums, and standard Tri-Sure Closures for other shipments.

Tri-Sure's exclusive assembly of *Flange, Plug* and *Seal* protects the contents from leakage, tampering and losses. And Tri-Sure's superior method of coating flanges and plugs—seals off the contents from the metal of the fittings.

Whether you use coated or uncoated containers, Tri-Sure Closures will assure the delivery of the exact quality and quantity you put into your drums. When you order drums, always specify *"Tri-Sure Closures."*

**The "Tri-Sure" Trademark is a mark of reliability backed by over 30 years serving industry. It tells your customers that genuine Tri-Sure Flanges (inserted with genuine Tri-Sure dies), Plugs and Seals have been used.*

Spraying lacquer on Tri-Sure Plugs

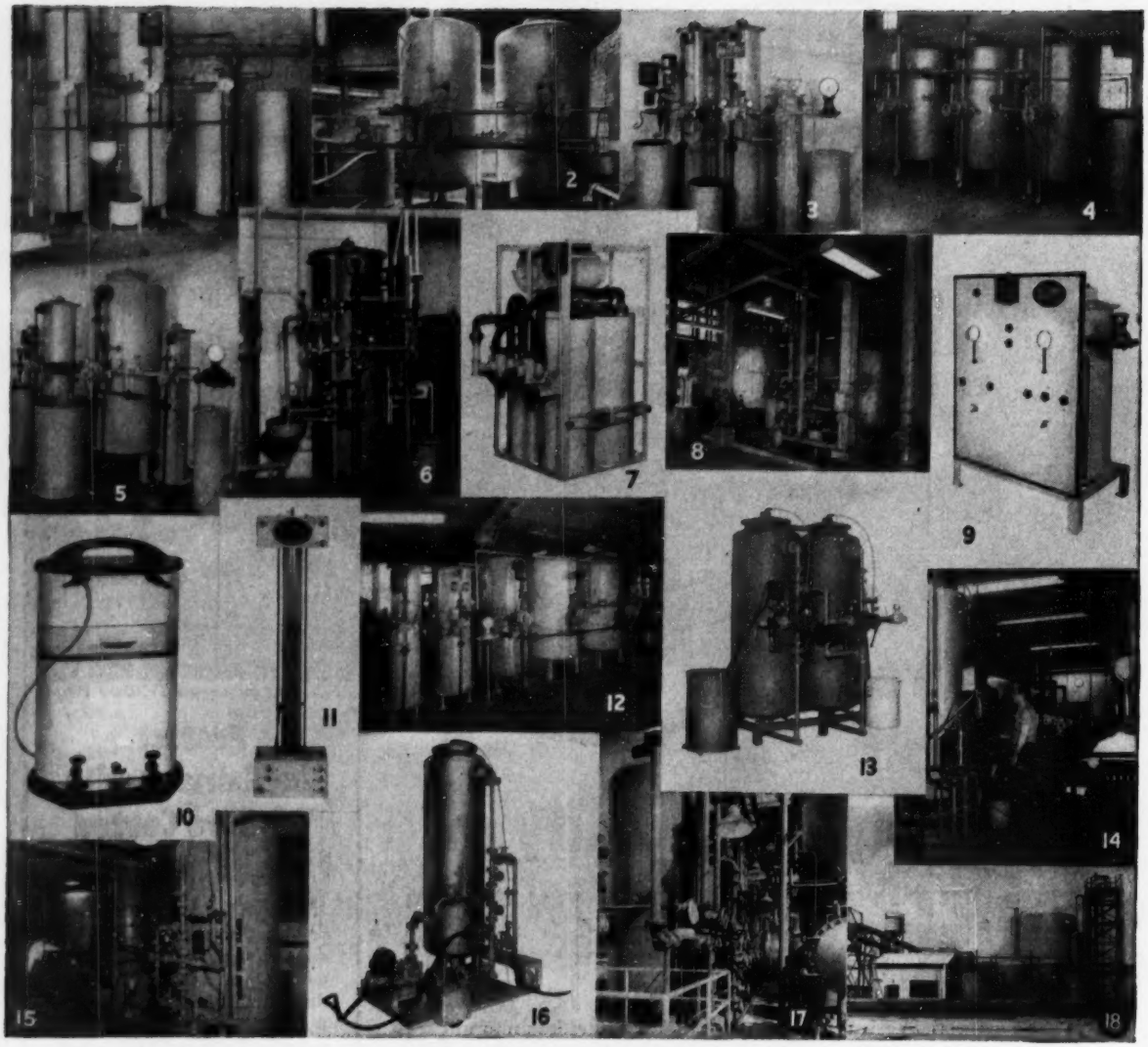
Protect lined drums with Tri-Sure Coated Flanges and Plugs

If you use lined or coated steel drums, properly coated *Tri-Sure Flanges and Plugs* will eliminate contact of your product with the metal of the fittings. Specify to your drum supplier *Tri-Sure* Flanges and Plugs, factory coated by us to the specification of the drum manufacturer. Coating is laid on evenly, and covers thread throughout. For lined or coated drums always specify *Tri-Sure Coated Flanges and Plugs.*

Always specify Tri-Sure CLOSURES

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.

Tri-Sure Products Limited, St. Catharines, Ontario, Canada



1. First D-I* installation (1939). 2. Parallel Dealkalizer (1940). 3. Standard D-I equipment (1944). 4. Triplex Softener for power plant. 5. D-I and Softener for distillery. 6. Early Mixed-Bed D-I (1949). 7. Special portable compact D-I unit. 8. Corn syrup purification. 9. Standard "package" D-I unit LU-340. 10. Laboratory D-I unit. 11. Laboratory "package" Mixed-Bed unit MB-510. 12. D-I high-purity water for dry cells. 13. Drug purification, foreign. 14. Mixed-Bed for television tubes. 15. Cation-aeration-Mixed-Bed special. 16. Portable Mixed-Bed for chromic acid recovery. 17. D-I for glycerine purification in soap plant. 18. Outdoor D-I at large chemical company. (*De-Ionizer)

EXPERIENCE is the Important Factor in the design and manufacture of Ion-Exchange equipment . . .

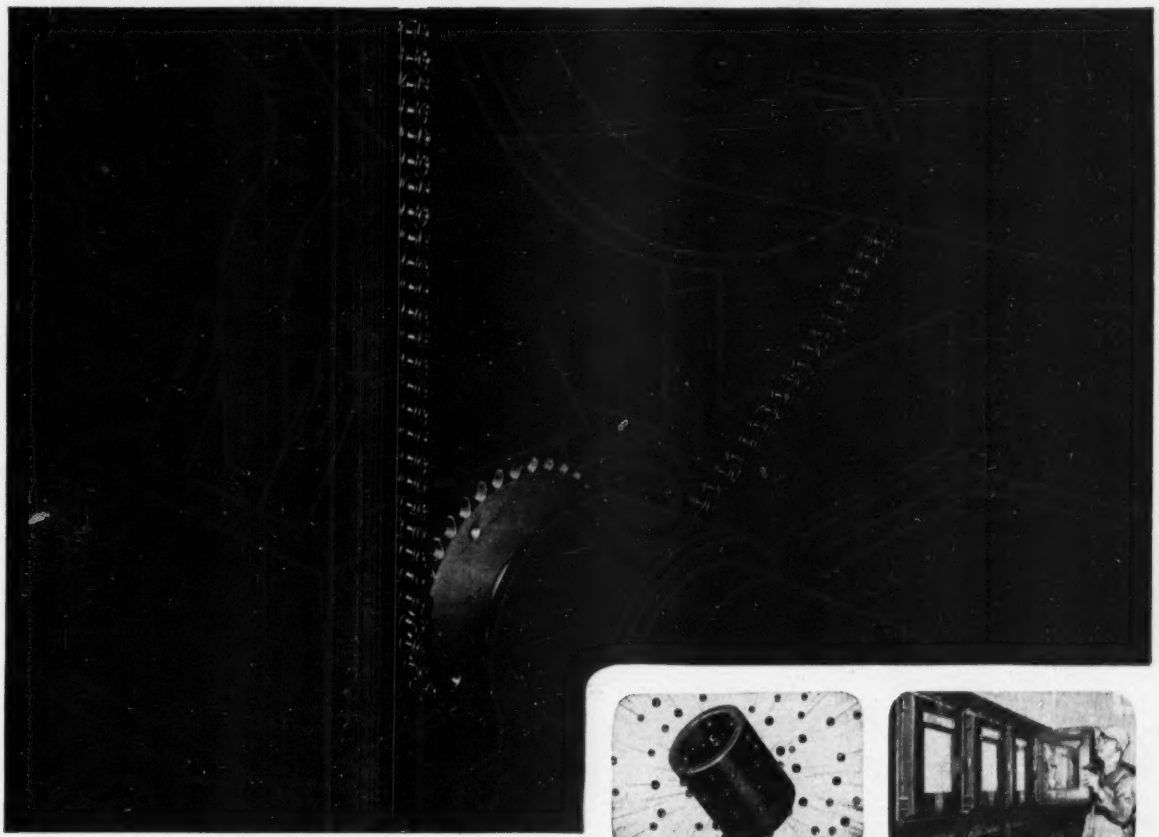
These pictures, and the dates associated with some of them, are indicative of two important considerations: (1) that Illinois Water Treatment Company has been making ion-exchange equipment continuously since 1939, which was only a few years after the idea of ion-exchange was first conceived, and was the same year that practical ion-exchange resins were developed, and (2) that, in this time, Illinois Water Treatment Company, has successfully designed, built, and installed a *wide range of practical equipment* for utilizing the advantages of ion-exchange in many different ways. *Remember* this record of accomplishment . . .

ILLCO-WAY

ionXchange

ILLINOIS WATER TREATMENT CO., 844 CEDAR ST., ROCKFORD, ILL.

How these EXTRAS * make roller chain last longer

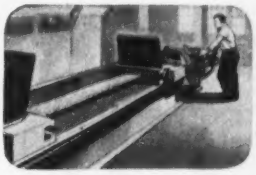


SHOT-PEENED ROLLERS have greater fatigue life, added ability to withstand impact.

CLOSER HEAT-TREAT CONTROL — coupled with rigid testing insures uniformity.



LOCK-TYPE BUSHINGS (applied on a range of sizes) end a cause of stiff chain.



PRE-STRESSING of multiple width chain provides uniform load distribution.

*And you pay no premium for these LINK-BELT extras

THERE'S more to roller chain than just the parts you see. *Much more!* It's the hidden extras—standard on Link-Belt Precision Steel Roller Chain—that add up to longer life and lower costs.

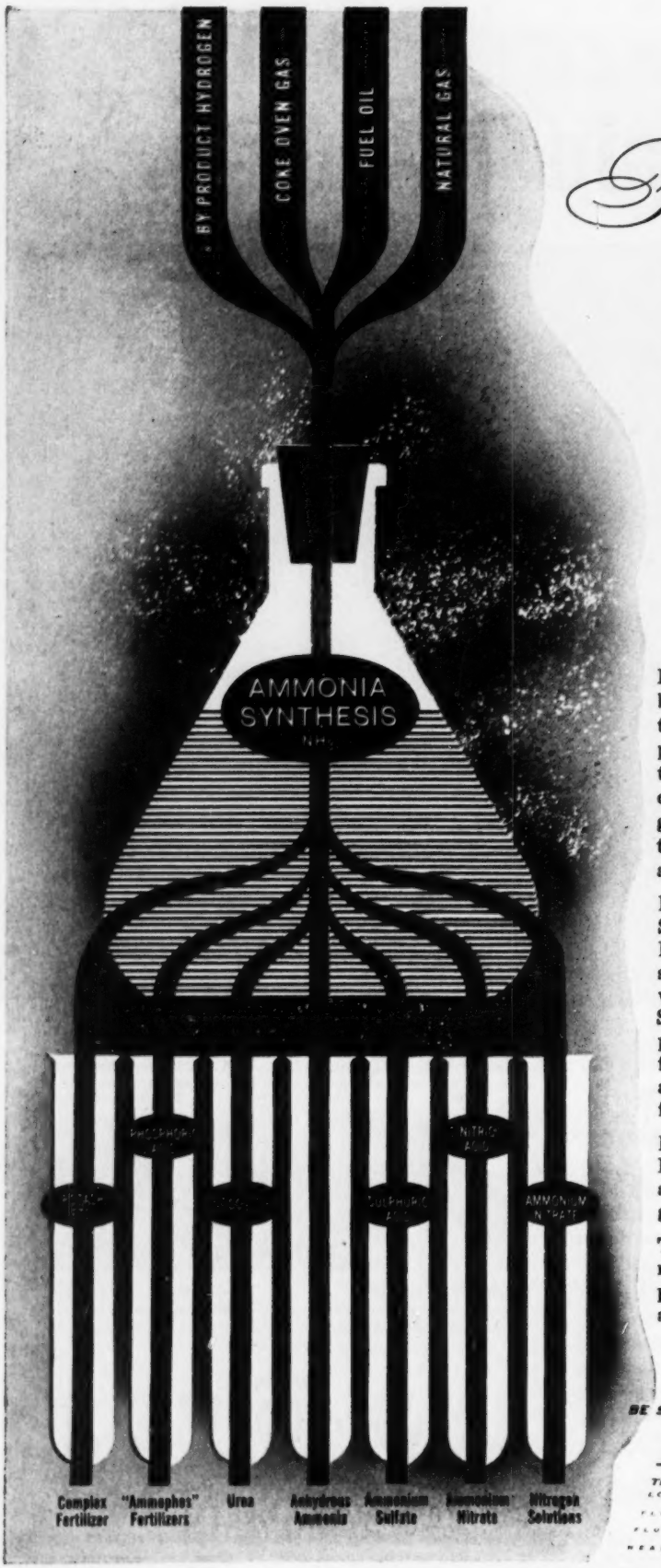
Check the four extras shown here. Then for your demanding drive and conveying jobs, choose from the complete line of Link-Belt roller chains and sprockets: Single or multiple widths, ¼" through 3" pitch. Double pitch, 1" through 3". There's full ordering and application information in 148-page Data Book 2457. Ask your Link-Belt office or distributor for a copy today.

LINK-BELT

ROLLER CHAIN & SPROCKETS

13,668

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Fluor combines process experience with two proven methods to design and build better ammonia plants

Fluor is presently engaged in designing and building four ammonia plants representing a total investment of over $40,000,000. Each plant will use a different raw material: electrolytic and other by-product hydrogen, fuel oil, natural gas, and coke oven by-product gas. There is a wide range of source materials that may be used in ammonia plants designed and built by Fluor.

By special agreement with L'Air Liquide Societé of France, Fluor is using the Claude Process, long recognized as the world's outstanding method of ammonia synthesis. Fluor will draw upon the valuable experience of the Societé which, for 30 years, has developed high pressure techniques to a high degree of perfection while building and operating its own ammonia plants, in addition to building plants for others throughout the world.

Fluor is also licensed to employ the Texaco Partial-Oxidation Process, by far the most advanced means of manufacturing the hydrogen gas from which ammonia is synthesized.

This broad ammonia experience plus Fluor's recognized ability to design and construct processing facilities is your key to a better ammonia plant.

BE SURE WITH

FLUOR

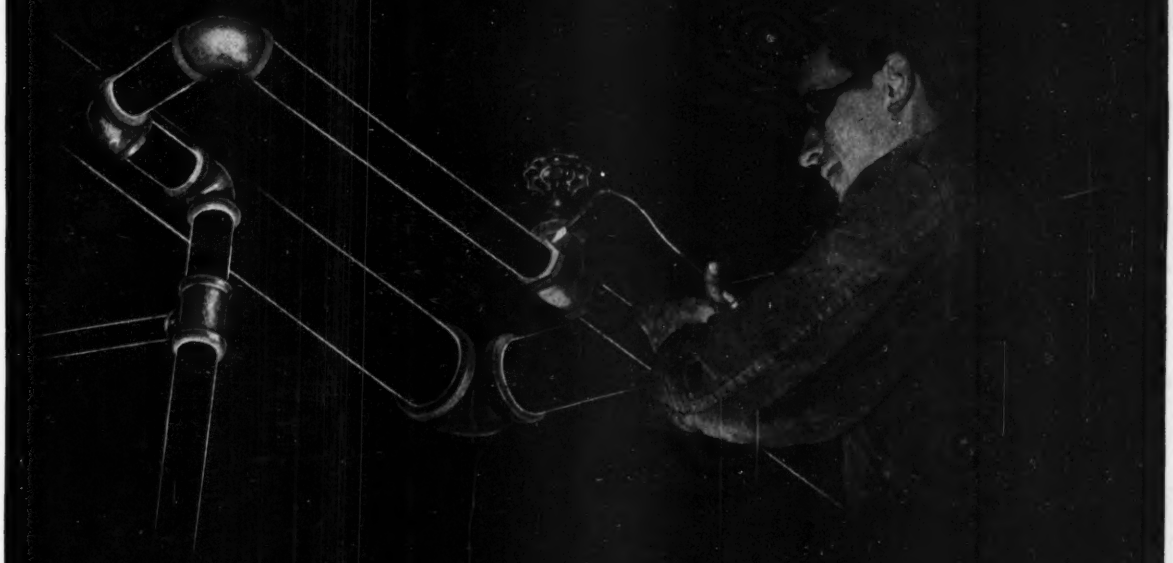
THE FLUOR CORPORATION, LTD
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WALSEAL® VALVES AND FITTINGS



Better because . . . **There's no guesswork when a silver-brazed joint is made with a Walseal fitting. Sil-Fos alloy, which appears as a fillet at the face of a Walseal joint, comes from rings which have been factory-inserted in the end connections of Walseal fittings. The bright silver alloy fillet that you can see assures full penetration of alloy for a permanently leakproof joint.**

Cutaway view of a Walseal Tee showing: factory-inserted ring of silver brazing alloy; fillet of silver brazing alloy that appears upon completion of Walseal joint; cutaway view of the completed joint showing that silver brazing alloy has flowed in both directions from the factory-inserted ring.

Walseal is a registered trade mark which identifies valves and fittings manufactured by the Walworth Company. Walseal products have factory-inserted rings of silver brazing alloy in threadless ports. Walseal joints can be made only with Walseal valves and fittings.

If you're piping water, oil, steam, air, oxygen, nitrogen, helium or other industrial gases or refrigerants through brass, copper, or copper-nickel pipe, you'll want to investigate Walseal — available in complete lines of valves and fittings in four distinct pressure ranges — from 0 to 5000 psi. working pressure*. Your copy of Circular 115 will be sent on request . . . see your near-by Walworth Distributor today, or write to: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

*Walseal fittings and valves are being used at sub-zero temperatures as low as —350 F.

Make it "a one-piece pipeline" with WALSEAL

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valves . . . pipe fittings . . . pipe wrenches

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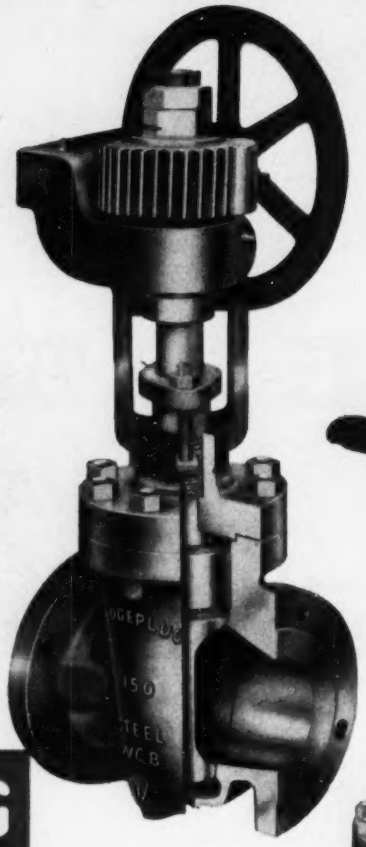
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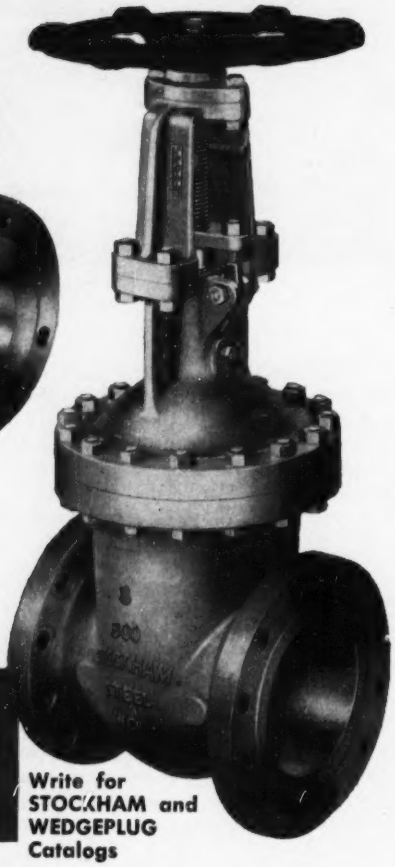
•at HIGH TEMPERATURE

•at LOW TEMPERATURE

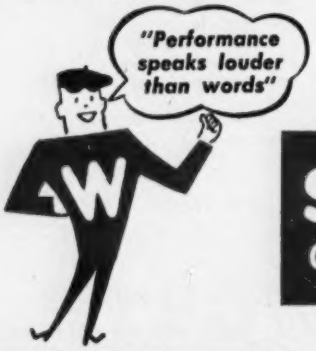
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"KNOW HOW" ASSURES THEIR GOOD PERFORMANCE



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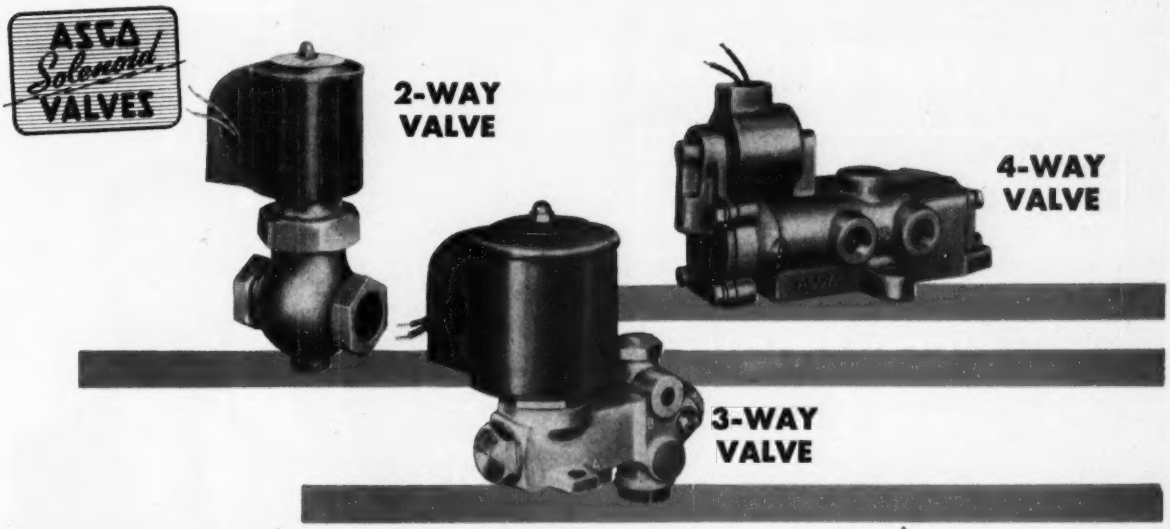
STOCKHAM
CAST STEEL GATE VALVES

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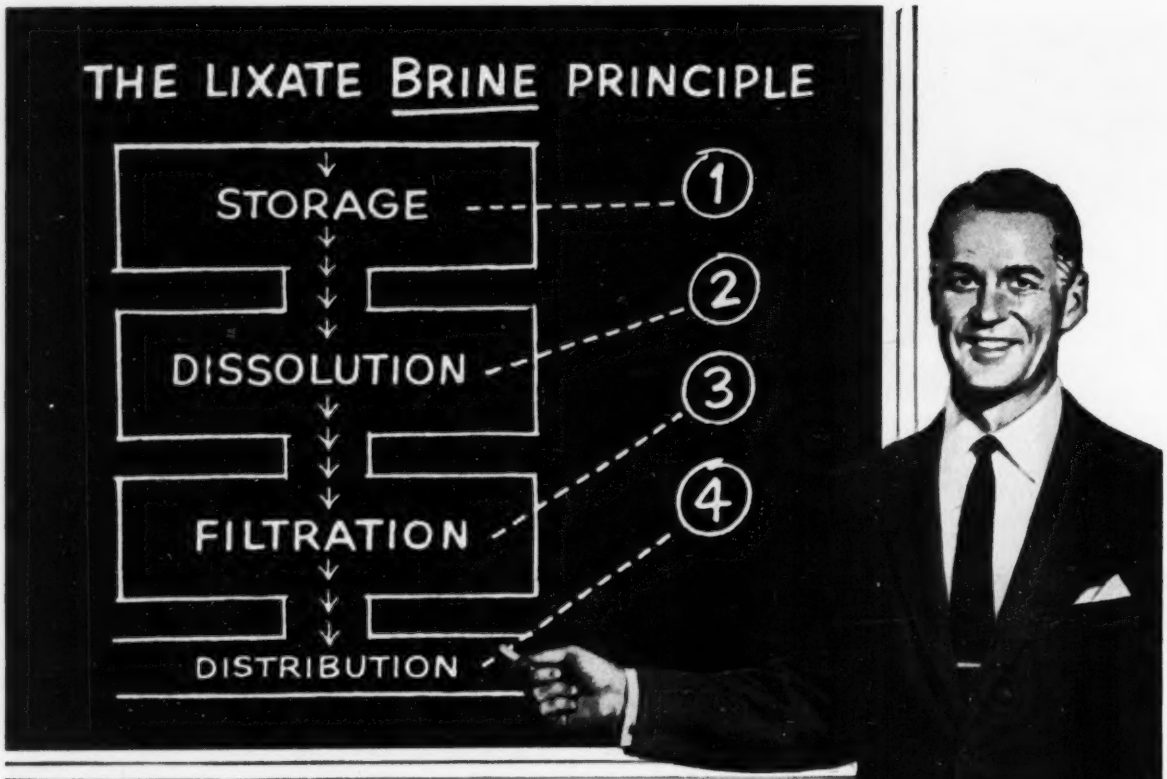
Our Valve Catalog No. 24 gives complete up-to-date information on the extensive line of ASCO Solenoid Valves. WRITE FOR YOUR FREE COPY TODAY!



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Simple Installation Cuts Handling and Labor Costs—Automatically Makes and Delivers Constant, 100% Saturated Brine to Any Point in Your Plant at the Twist of a Wrist.

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HOW THE LIXATOR WORKS

1. Sterling Rock Salt is stored right in the hopper of the Lixator. Automatically, it feeds by gravity to . . .
2. the Dissolution Zone where water dissolves the rock salt to 100% saturated brine.
3. Gravity then filters the brine through a bed of *un*dissolved rock salt and
4. it flows, or is pumped, through the pipes directly to where you need it!

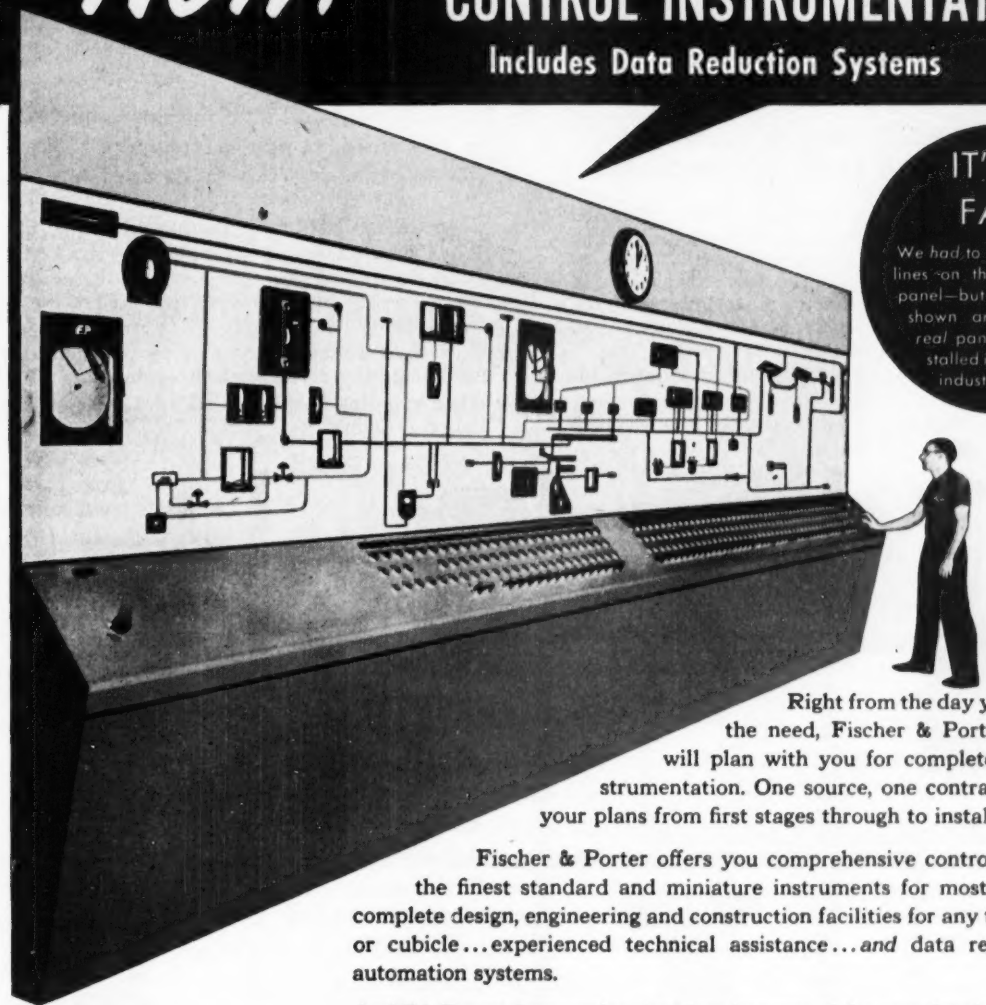
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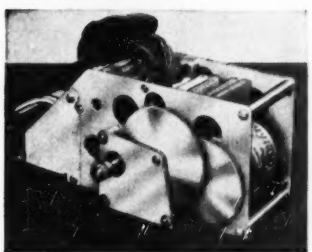
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Leslie Controllers consist of a single or double seated diaphragm control valve operated by a Control Pilot. The latter is an air, water or oil actuated device that produces a variable loading pressure to the valve diaphragm in response to a pressure, temperature or level change in the controlled medium. Controllers are used for any one or any combination of the following conditions:

★ When an exactly controlled level, pressure or temperature is required.

★ When power is needed to assure automatic valve opening after prolonged, tight shut-off.

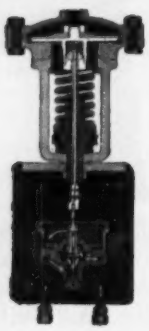
★ When power is needed to operate single-seated valves under high pressure drop.

★ When the available fluid pressure differential doesn't supply enough power for self-operation.

★ When extreme pressure reductions are necessary (i.e. 600 reduced to 10 psi, 900 to 2 psi, 2150 to 5 psi); all can be handled in one step.

★ When fluid contamination requires the simplest type regulating valve for dependable operation.

★ When operation from either a nearby or remote control station is desired.

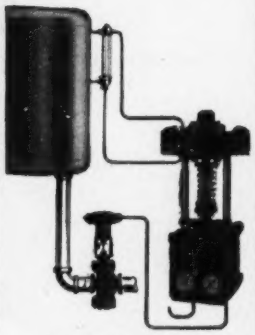


Control Pilot
Type PD

LESLIE
CONTROL PILOTS

Simple mechanical device employing constant supply of clean air, gas, water or light oil at 20-22 psi to produce a variable output or loading pressure of 0-20 psi in response to a level, pressure or temperature change applied to operate a control valve or power cylinder controlling fluid flow.

SEND FOR BULLETIN 5303



Floatless Level Control
Type UA-1

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FLOATLESS LEVEL CONTROL

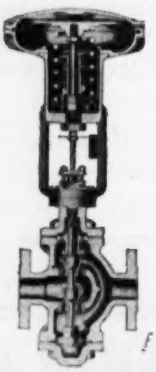
Provides accurate control of liquid level (plus or minus 1" water column). Eliminates problems caused by troublesome linkages, torque tubes, floats and stuffing boxes. Simple design provides steady, positive, precise control even under difficult conditions. Consists of Level Control Pilot and diaphragm control valve.

SEND FOR BULLETINS
5303, 5304, 5305

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(Double Seated)

Flow-line contoured body for high capacity, low pressure drop. Standard IRA face to face dimension in cast iron, cast bronze and cast alloy steels. Renewable, self-aligning guides. ½-10". To primary service rating of 600 psi—050° F. flanged, ring joint and welding ends.

SEND FOR BULLETIN 5305

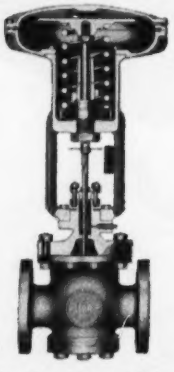


Diaphragm Control Valve
Double Seated Class DV

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DIAPHRAGM CONTROL VALVES
(Single Seated)

Control flow of steam, liquid, air or gas. Tight shut-off. Operated automatically by air, water or oil pressure supplied from a Control Pilot or from a loading device such as LESLIE Air Loading panel. Available in unbalanced or fully balanced types, ½-10" in cast bronze, cast iron and cast alloy steels. Primary service ratings to 2500 psi, 1000° F.

SEND FOR BULLETIN 5304



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Single Seated Class DL-1

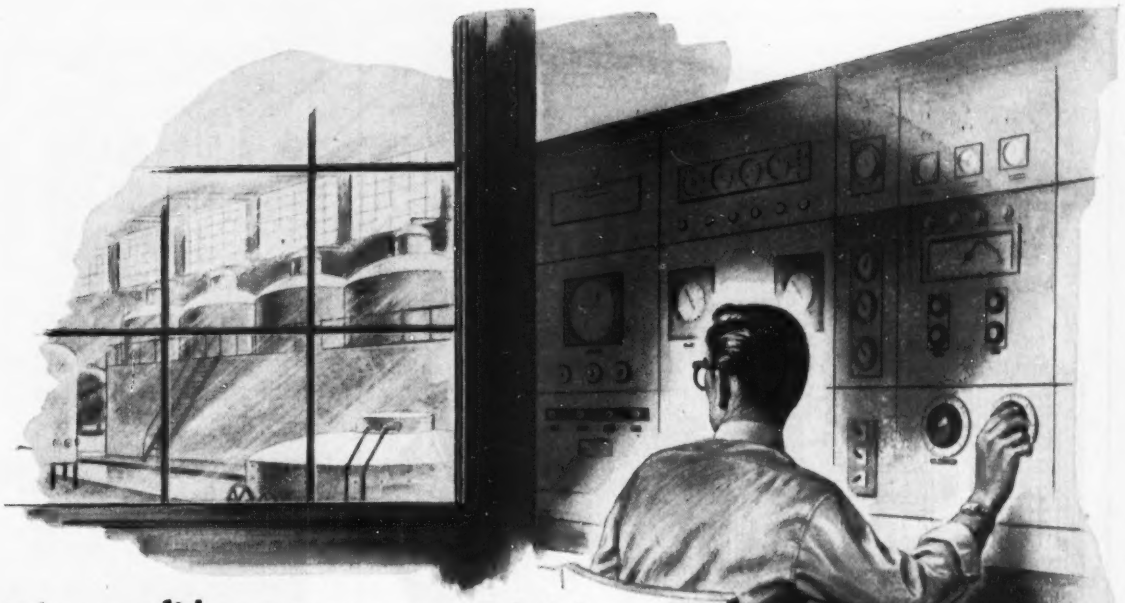
3100

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SINCE 1900

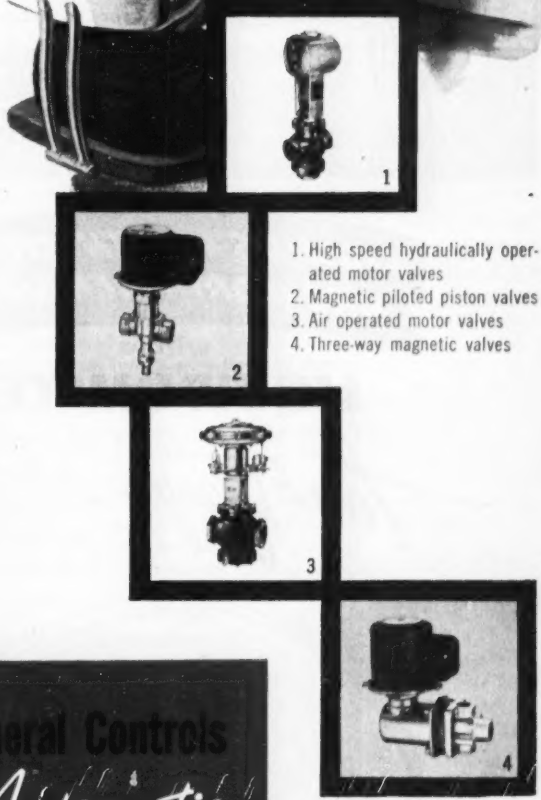
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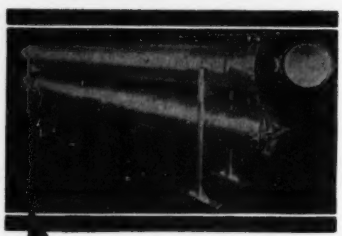
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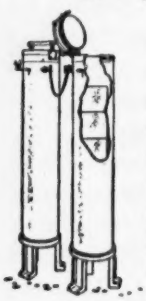
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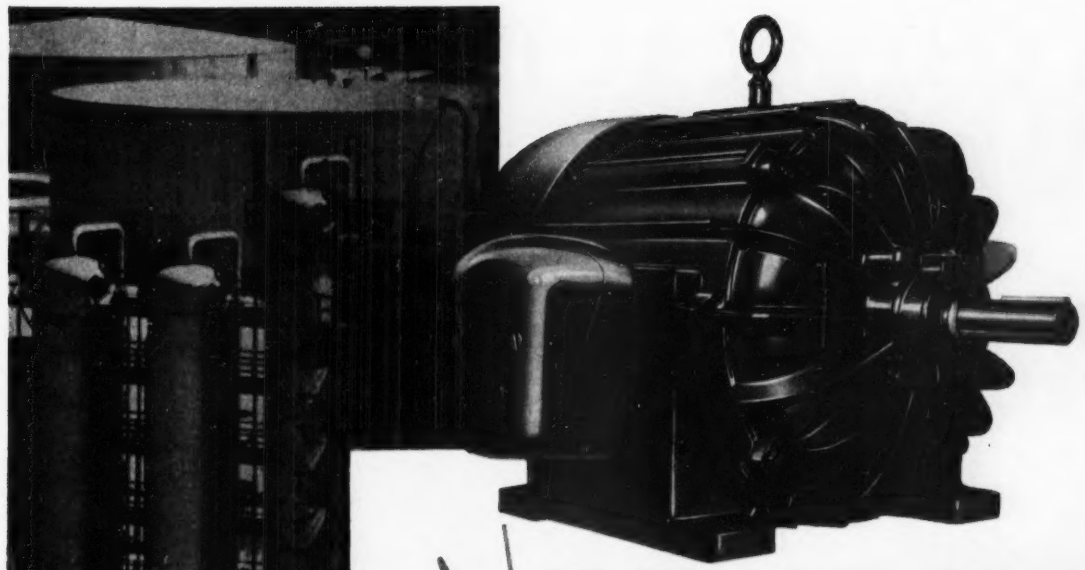
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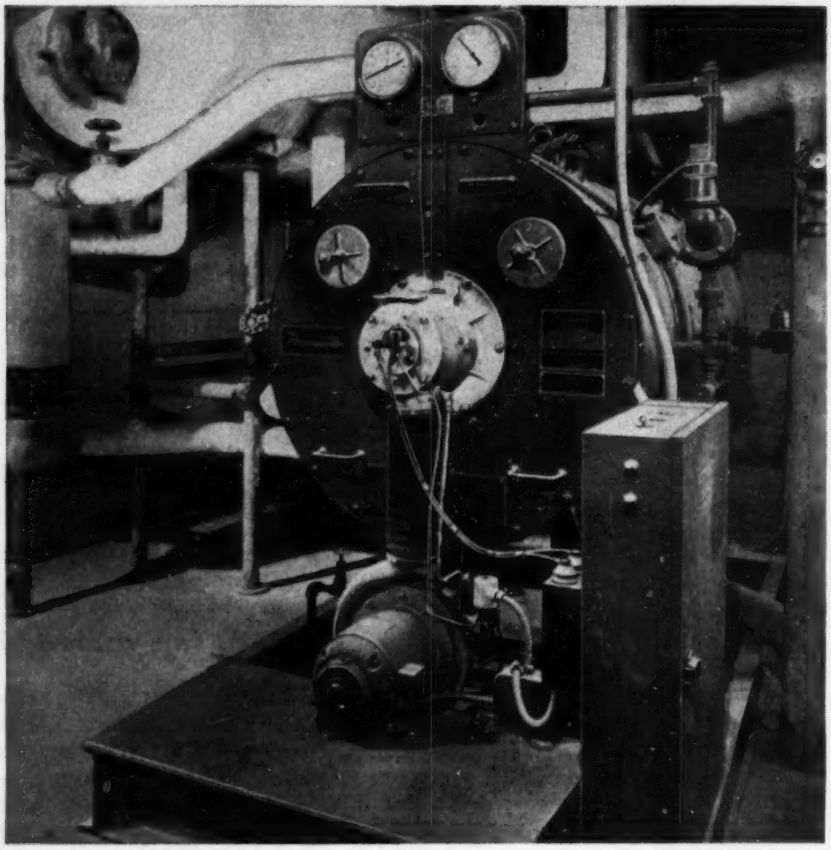
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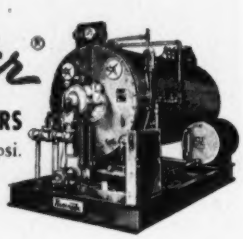
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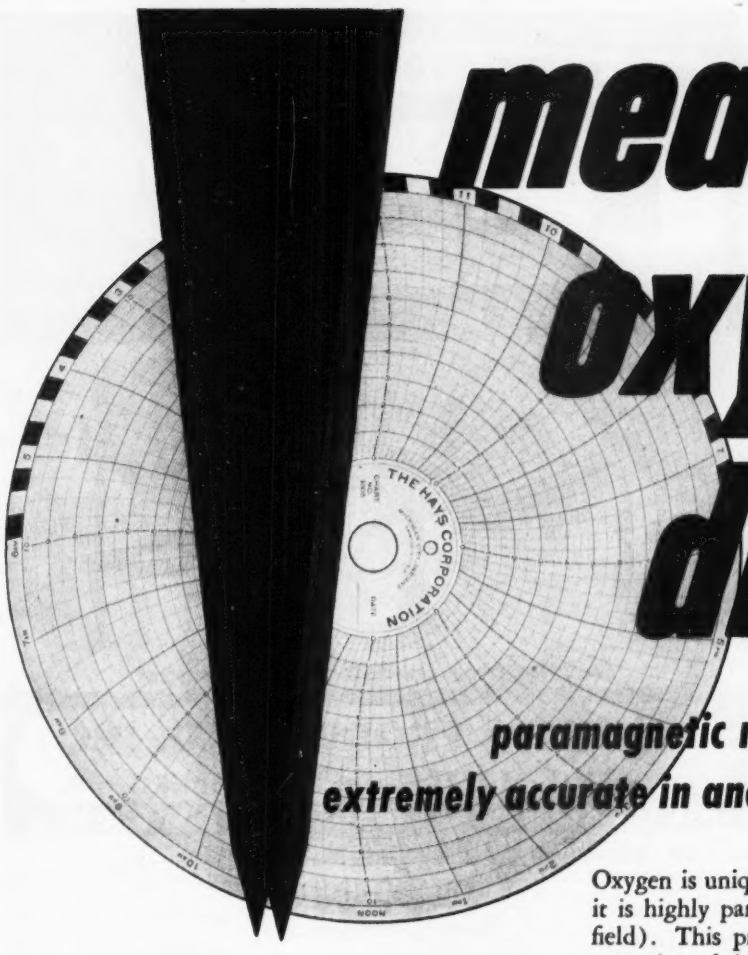
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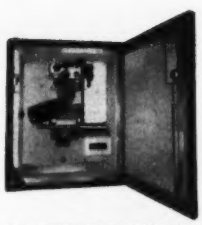
paramagnetic method of measurement extremely accurate in analyzing industrial gases

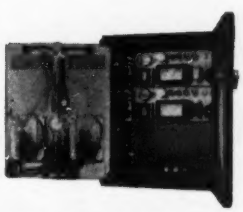
Oxygen is unique among other common gases in that it is highly paramagnetic (attracted into a magnetic field). This property of oxygen is the basis of the operation of the Hays Magno-Therm Analyzer in the analysis of industrial gases.

application

Hundreds of companies are using the Hays Magno-Therm O_2 Analyzer and Recorder in applications from revivification of SO_2 removers in manufactured gas industry and regeneration of catalysts in oil refineries to mixing air with propane to get substitute fuel. Boiler plants use it as a combustion guide because it is the only means of getting an undistorted picture of excess air.

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No liquid or gaseous fuel required to be added to gas sample.	Immediate response—analyzer is continuously connected to recording pen drive motor.
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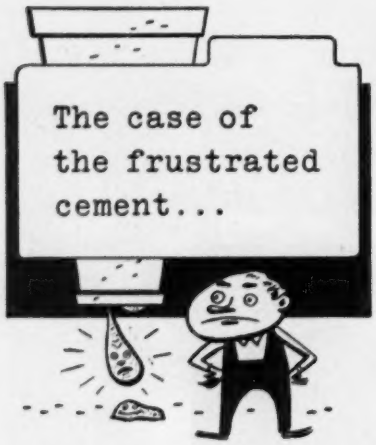


Mile Rock Light guards the south side of the channel leading through the Golden Gate into San Francisco Bay, one of the world's finest land-locked harbors. The lighthouse, built on top of Mile Rock, is constructed of steel and concrete upon a massive monolithic concrete base 34 feet high. The top of the beacon is 90 feet above mean low water. On the opposite side of the Golden Gate is Point Bonita Light.

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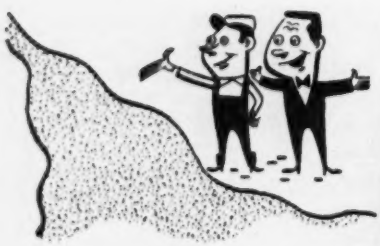
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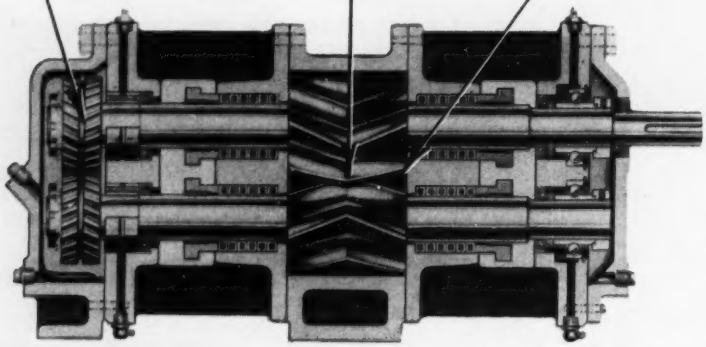
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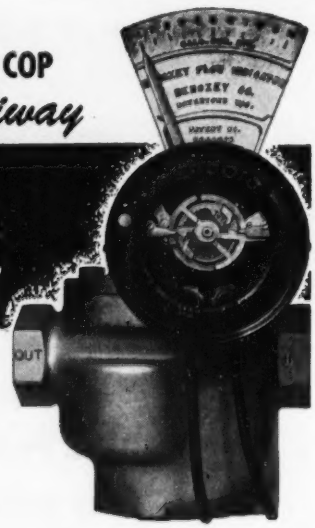
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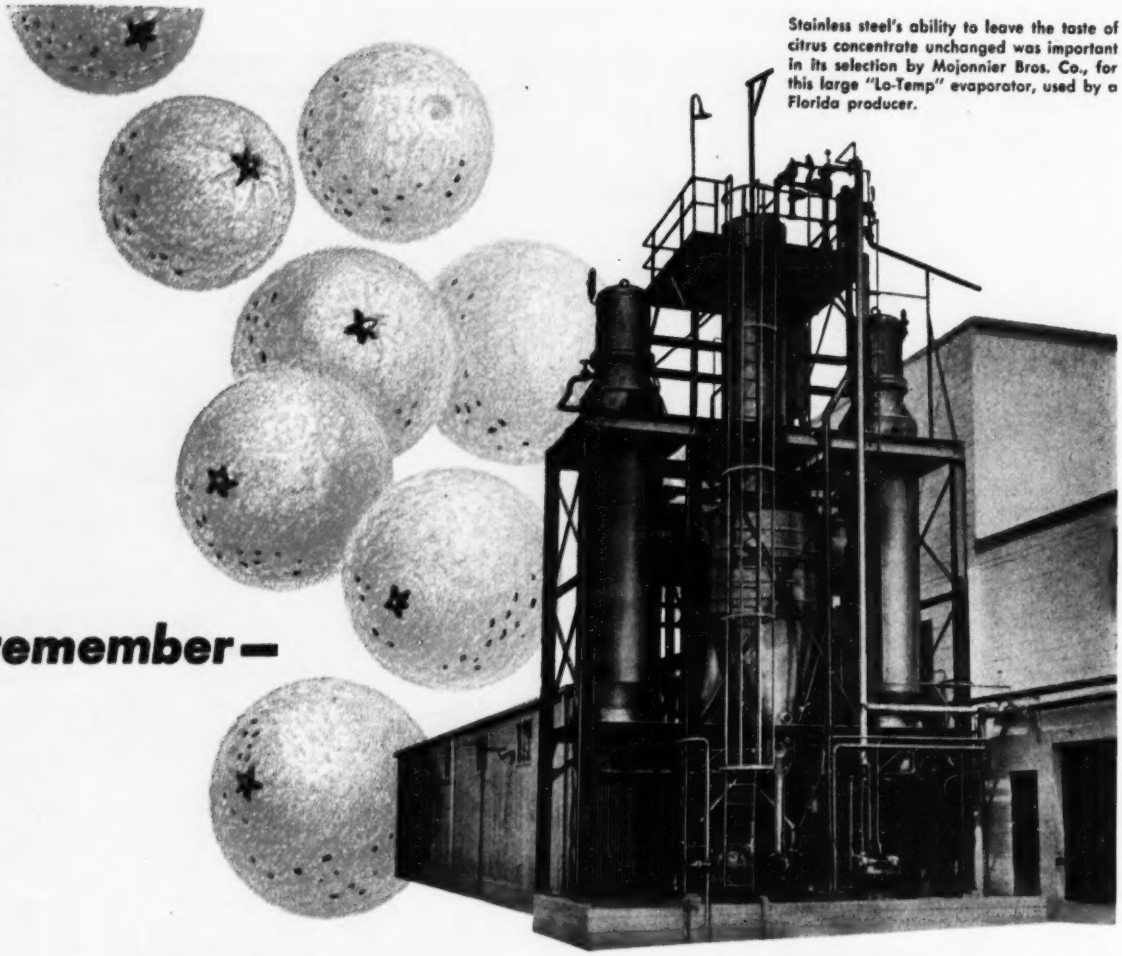
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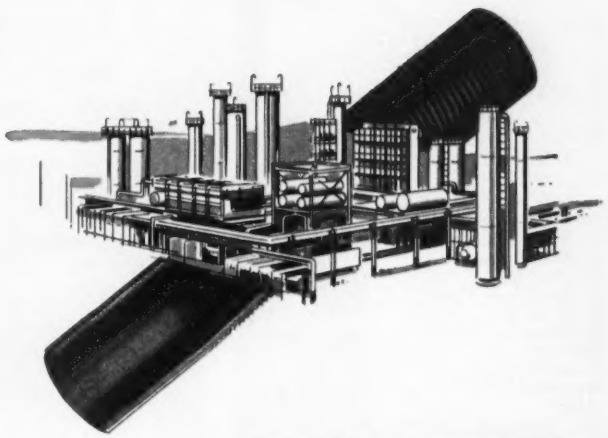


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	PLAIN TUBE	TRUFIN TYPE S/T
Shell Size, O.D.	12¾"	12"
Tube Length	7'	7'
Tube Specification	⅝" OD—18BWG 90-10 Cu. Ni.	⅝" OD—18BWG 90-10 Cu. Ni. Trufin Type S/T
Outside Surface Sq. Ft.	143.34	334.0
No. of Tube Passes	4	2
On the basis equivalent water flow Water Flow USGPM	102.0	107.2
Water Velocity, FPS	4.68	3.32
Heat Load BTU/(Hr.)	411,000	652,000
U_d, BTU/(Hr.) (°F) (Sq. Ft.)	186.3	155.2
U_l, BTU/(Hr.) (°F) (Lineal Ft.)	30.6	63.0
On the basis equivalent water velocity Water Flow, USGPM	102.0	152.5
Water Velocity, FPS	4.68	4.72
Heat Load, BTU/(Hr.)	411,000	829,000
U_d, BTU/(Hr.) (°F) (Sq. Ft.)	186.3	180.2
U_l, BTU/(Hr.) (°F) (Lineal Ft.)	30.6	73.0
Calculated heat Loads with a fouling factor of 0.0005	390,000	575,000

From the data, the advantage of TRUFIN can be clearly seen either on an equivalent water consumption basis or an equivalent water velocity basis.

Although this data was obtained on a clean tube basis, we have shown calculated values on the basis of a fouling factor of 0.0005 (considered to be standard for this service.)

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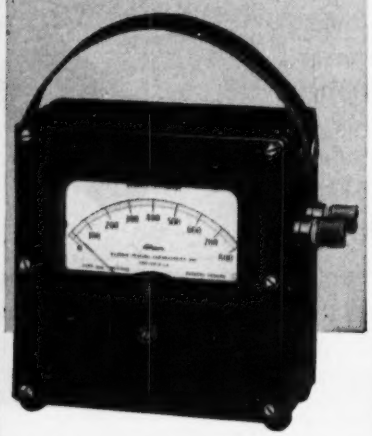
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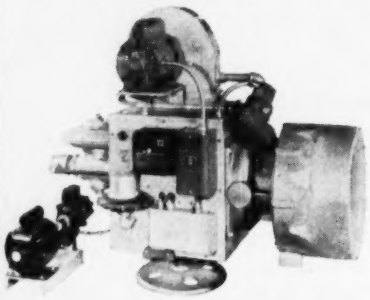
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This new Eclipse Gas - Oil Burner saves heating time, fuel cost, and maintenance. Like a jet engine, the new "CF" injects air and mixture in *converging* and *rotating* patterns, completely atomizing the fuel and assuring "top" combustion efficiency.

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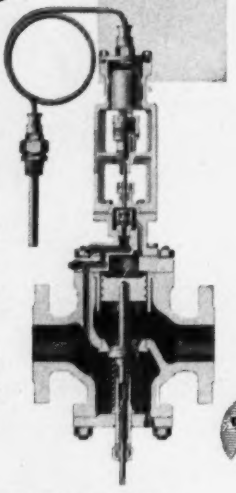
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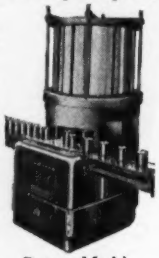


VACUFLOW

POWDER FILLERS

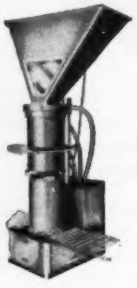
Cut Product Wastage. Vacuflow powder filling equipment operates on a principle of vacuum feeding, instead of pressure, to pack powder into a container.

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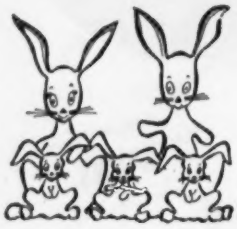
Model E

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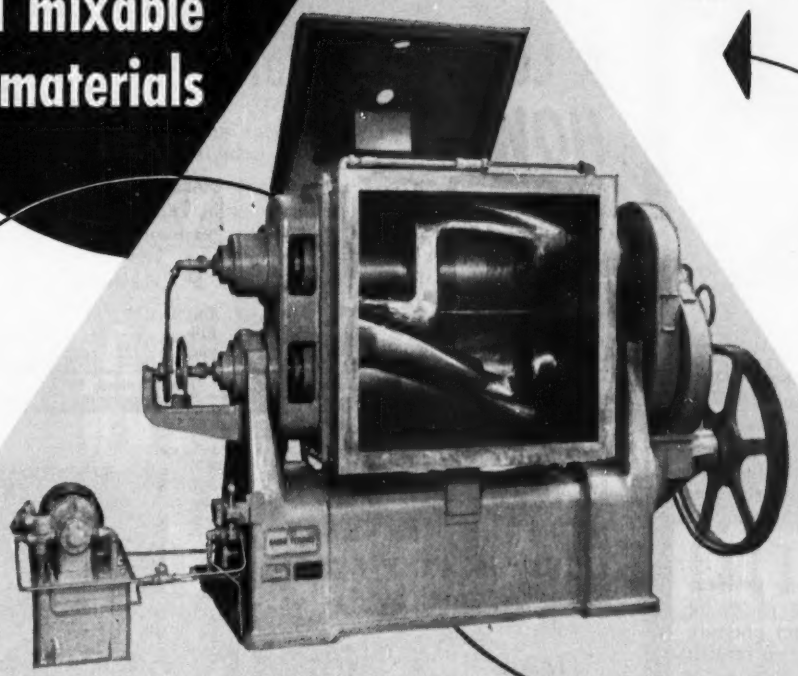
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Fig. 645

Are your scrubbing nozzles as efficient as you think they could be? Do they resist the corrosion or wear conditions satisfactorily — produce the breakup and distribution you would like?

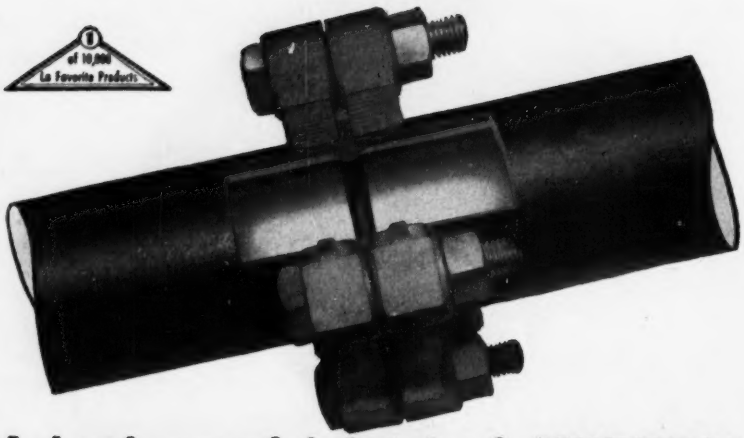
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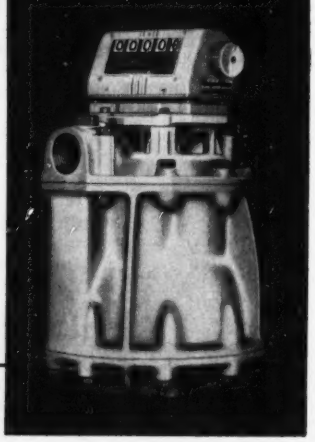
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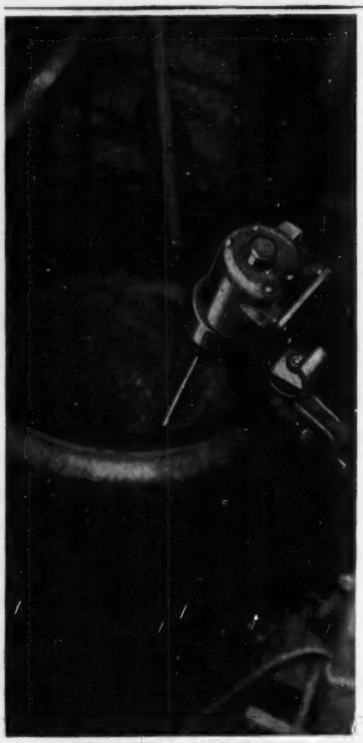
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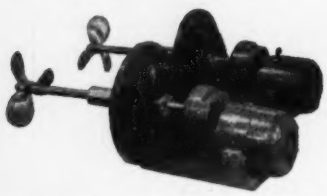
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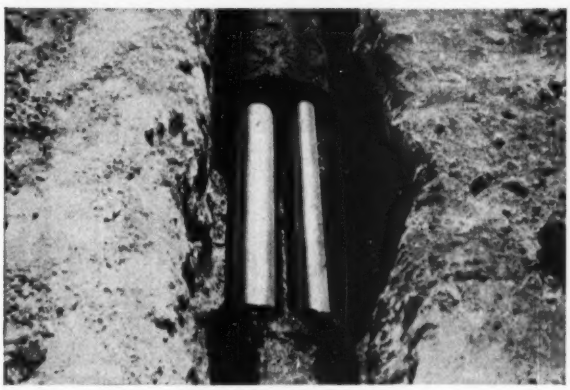
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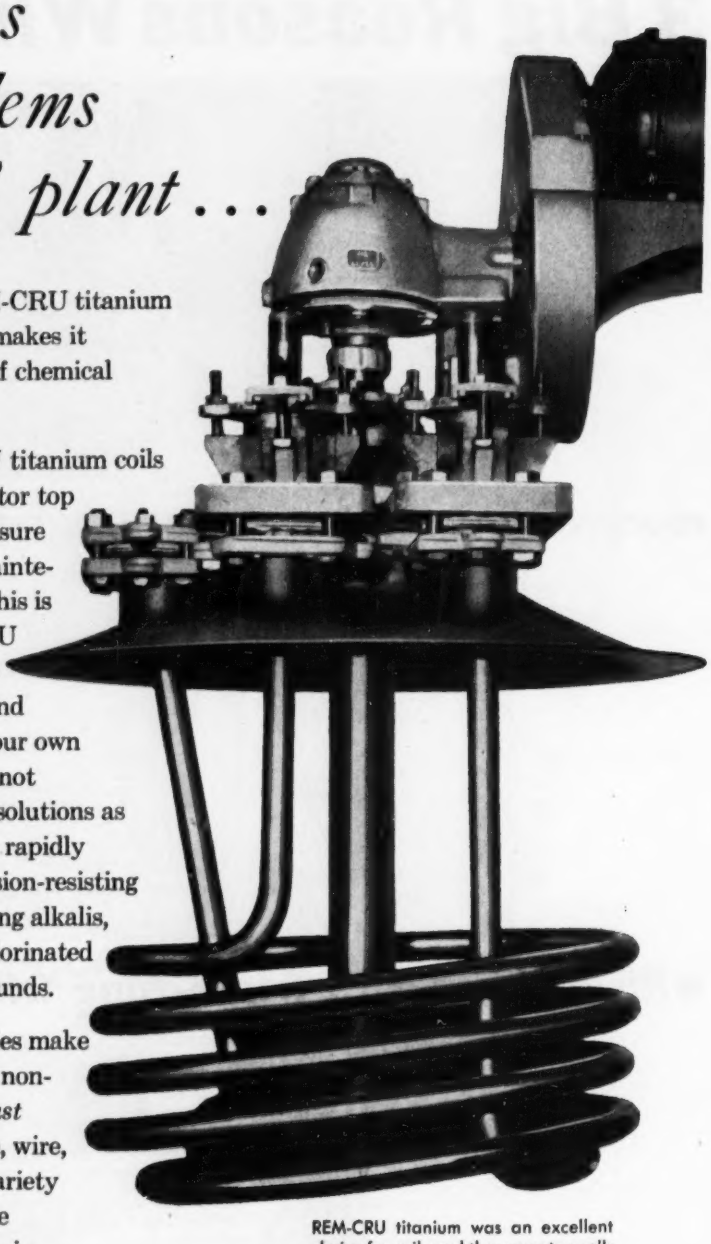
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Titanium solves corrosion problems in the chemical plant . . .

The unmatched resistance of REM-CRU titanium to most forms of corrosive attack makes it the logical choice for many parts of chemical processing equipment.

Take, for example, the REM-CRU titanium coils and thermometer wells on the reactor top head assembly illustrated. They insure long service life, with minimum maintenance or loss of production time. This is just one example of how REM-CRU titanium pays its way in the chemical processing industry . . . you'll find dozens of similar applications in your own plant. For REM-CRU titanium is not attacked by such highly corrosive solutions as chlorides and hypochlorites, which rapidly attack other commonly used corrosion-resisting metals. It is also impervious to strong alkalis, sulphur or sulphur compounds, chlorinated solvents, and many organic compounds.

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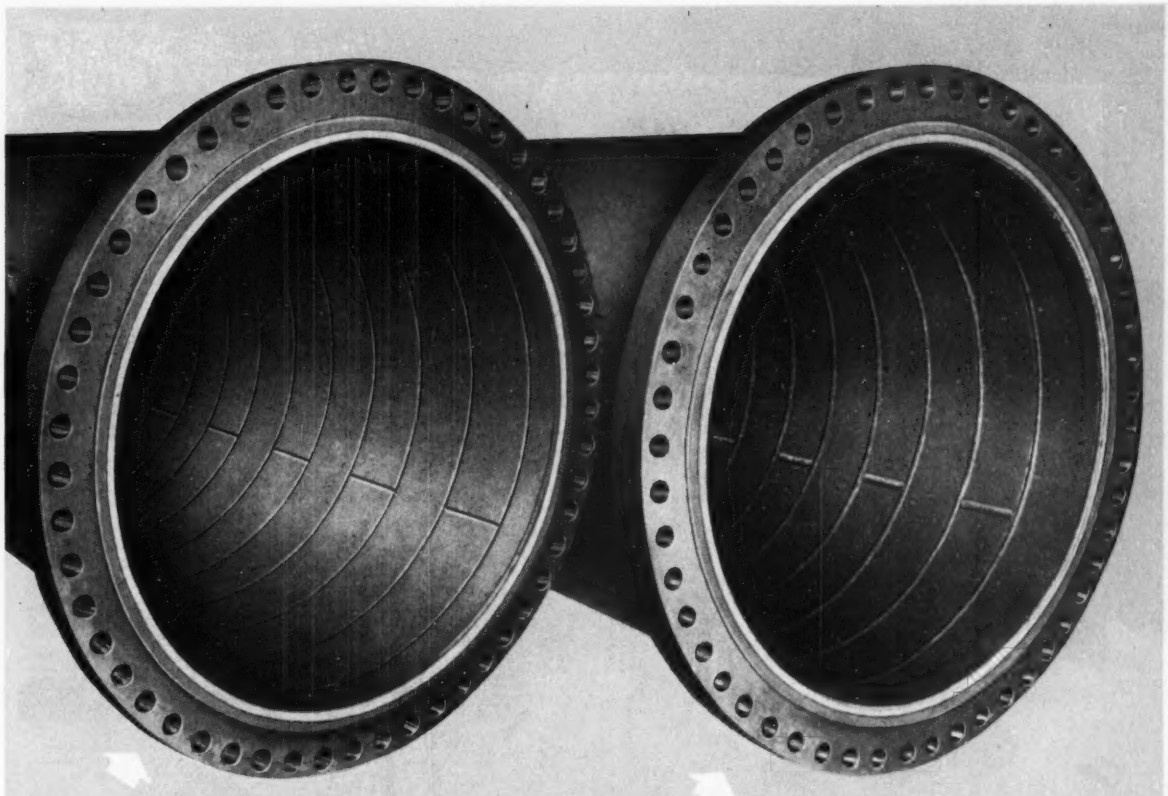


REM-CRU titanium was an excellent choice for coils and thermometer wells of this reactor top head assembly, fabricated by the Pfaudler Company.

To keep abreast of the latest developments on this vital metal, write for the Rem-Cru Review—a free periodical devoted to the application and fabrication of titanium alloys.

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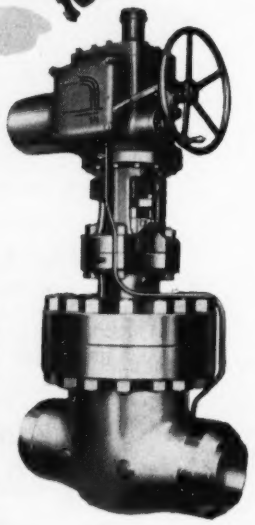
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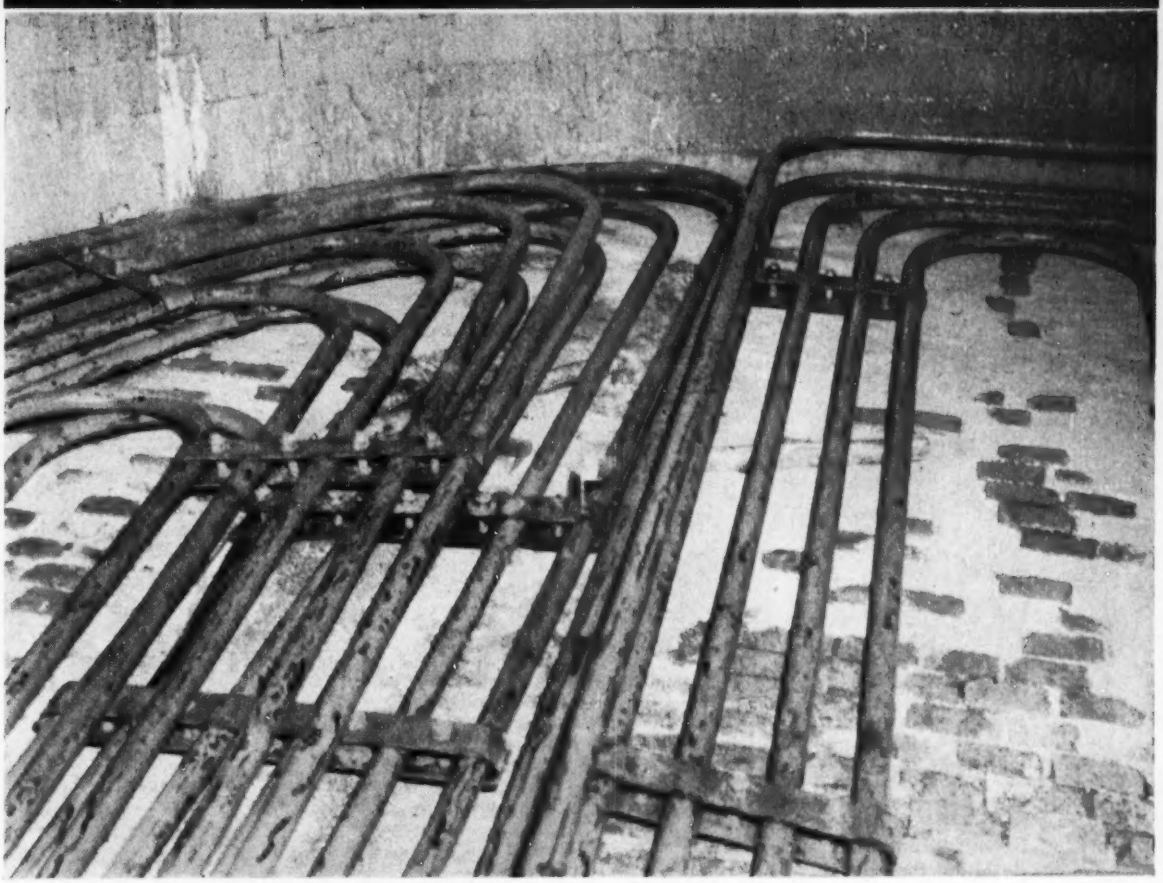
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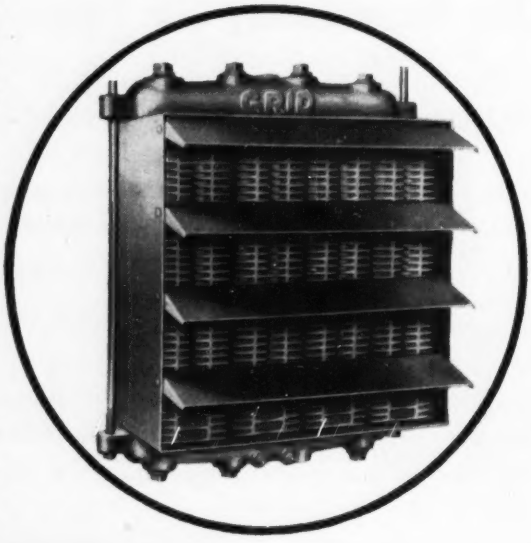
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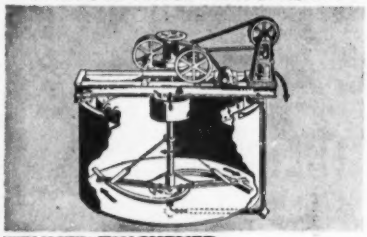
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DENVER EQUIPMENT

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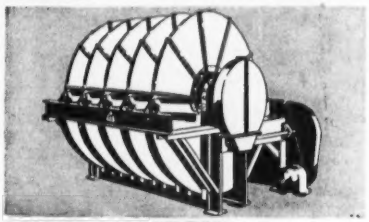


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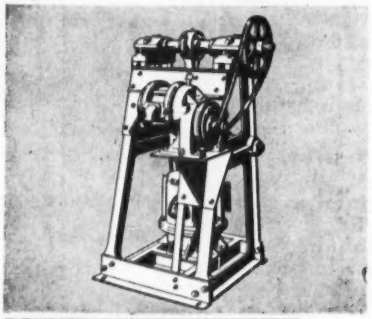


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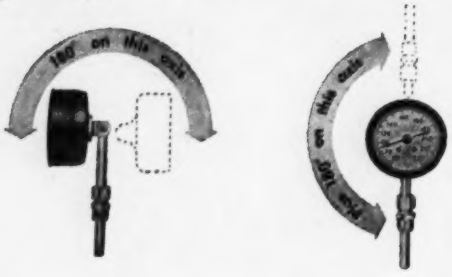
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WEATHER-PROOF DESIGN. *Screw-type ring* with tight-fitting gasket for weather-proof outdoor service; *slip ring* design for indoors.

REINFORCED MOUNTING. Heavy-gauge swivel hinge has a *stainless steel kingpin.* Reinforced connection between hinge and bulb. Greater strength and corrosion resistance, long service life!

EASY INSTALLATION. Socket connections have compression-type bushings. No costly jigs needed — connection easily welded to tanks or other irregular-shaped equipment.

Ask your Distributor to help you select the American "Every Angle" Dial Thermometers with the proper temperature ranges for your needs. Phone or write him today.

SPECIFICATIONS

NON-CORROSIVE DIAL CASE: Non-corrosive aluminum with smooth black finish. No protruding screw heads. Nickel-plated brass cup houses coiled capillary tubing.

DIAL: 3½" diameter. White with black figures. **POINTER:** Black, adjustable. **FRONT:** Heavy plate glass. **MOVEMENT:** Bronze or stainless steel. **BULB AND STEM:** Stainless steel. **SIZE CONNECTION:** ½", N.P.T. **STEM-LENGTHS:** 3", 5-5/16", 12", 18" and 24". **SEPARABLE SOCKETS:** Bronze, carbon steel or stainless steel.

STANDARD RANGES

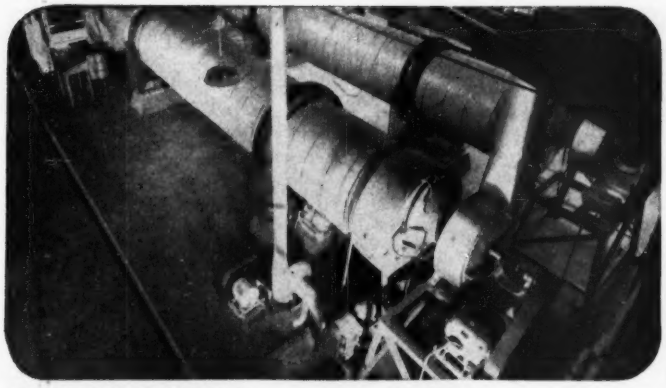
Fahrenheit	
—60 to 20°	30 to 300°
—20 to 120°	100 to 300°
40 to 140°	90 to 350°
30 to 180°	190 to 390°
20 to 220°	260 to 450°
Centigrade	
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If your products are not critical to high temperatures they can be dried more economically in a "DAVENPORT" Flash or Direct fired dryer. Precision controls can be furnished with dryer which will assure absolute control of temperatures.

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Steam Tube, Hot Air and Direct Fire Dryers
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PROPELLERS
for MIXING, STIRRING, AERATING, PUMPING, etc.

Manufactured by an exclusive process, MICHIGAN propellers are perfectly balanced to avoid whip and strain on shafts. And because of their superior functioning are now standard parts of the products of many leading equipment manufacturers.



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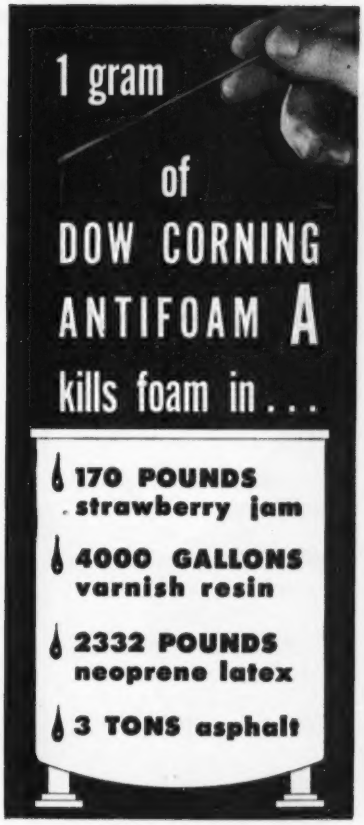
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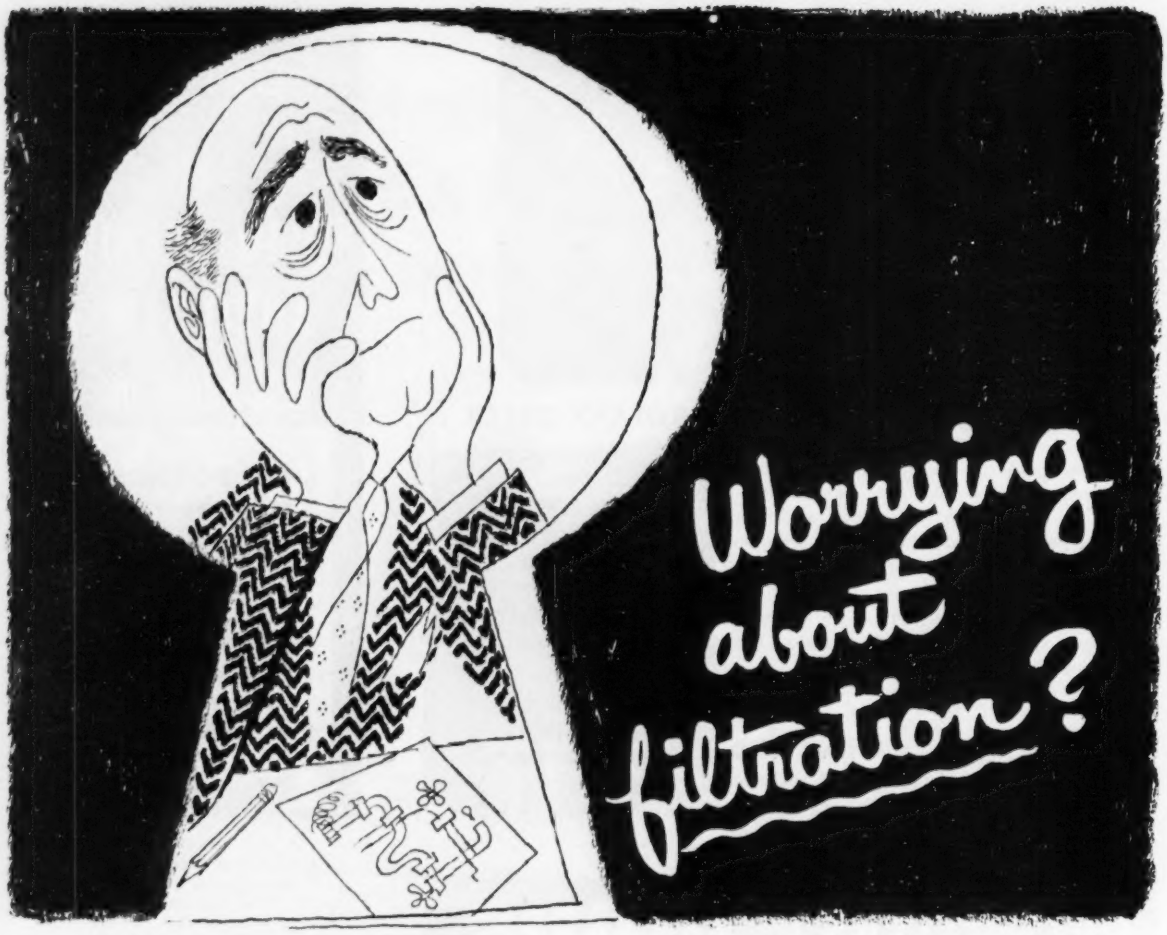
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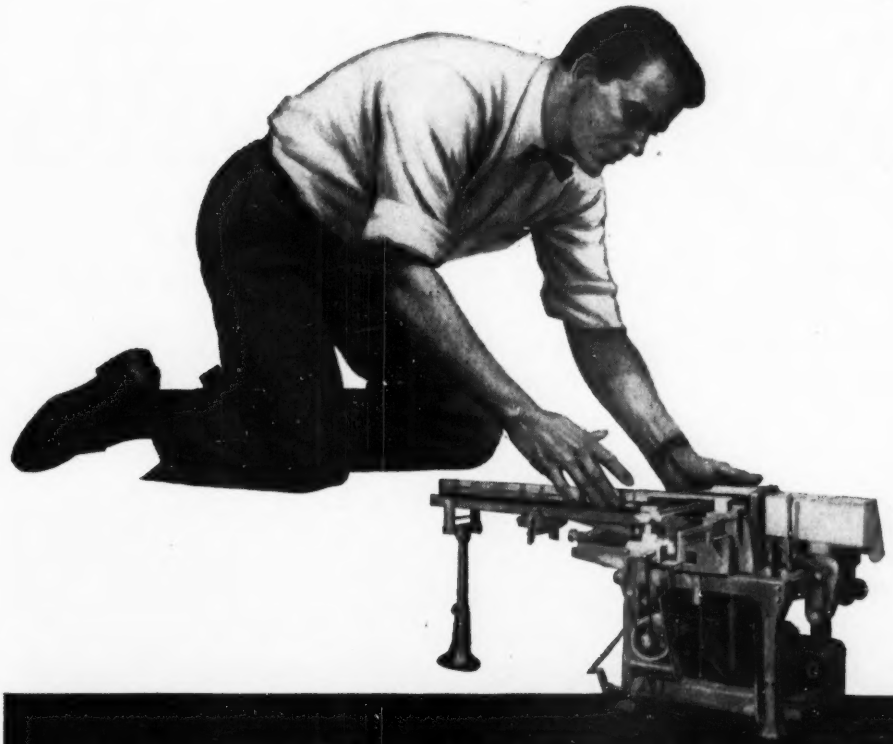
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Standard-Knapp Carton Packers handle all sizes and shapes of cartons — both boxes and bags. They automatically load each shipping case exactly as required, according to almost any predetermined pattern. They pack through the end, side or top of the case. Filled cases are automatically loaded to an off-bearing conveyor and moved to a Standard-Knapp Case Sealer and Gluer. Display cases are handled as readily as regular shipping cases. Several models are also designed to load bags into bales.

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Only the best is good enough

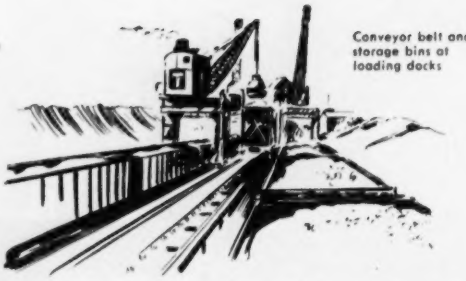
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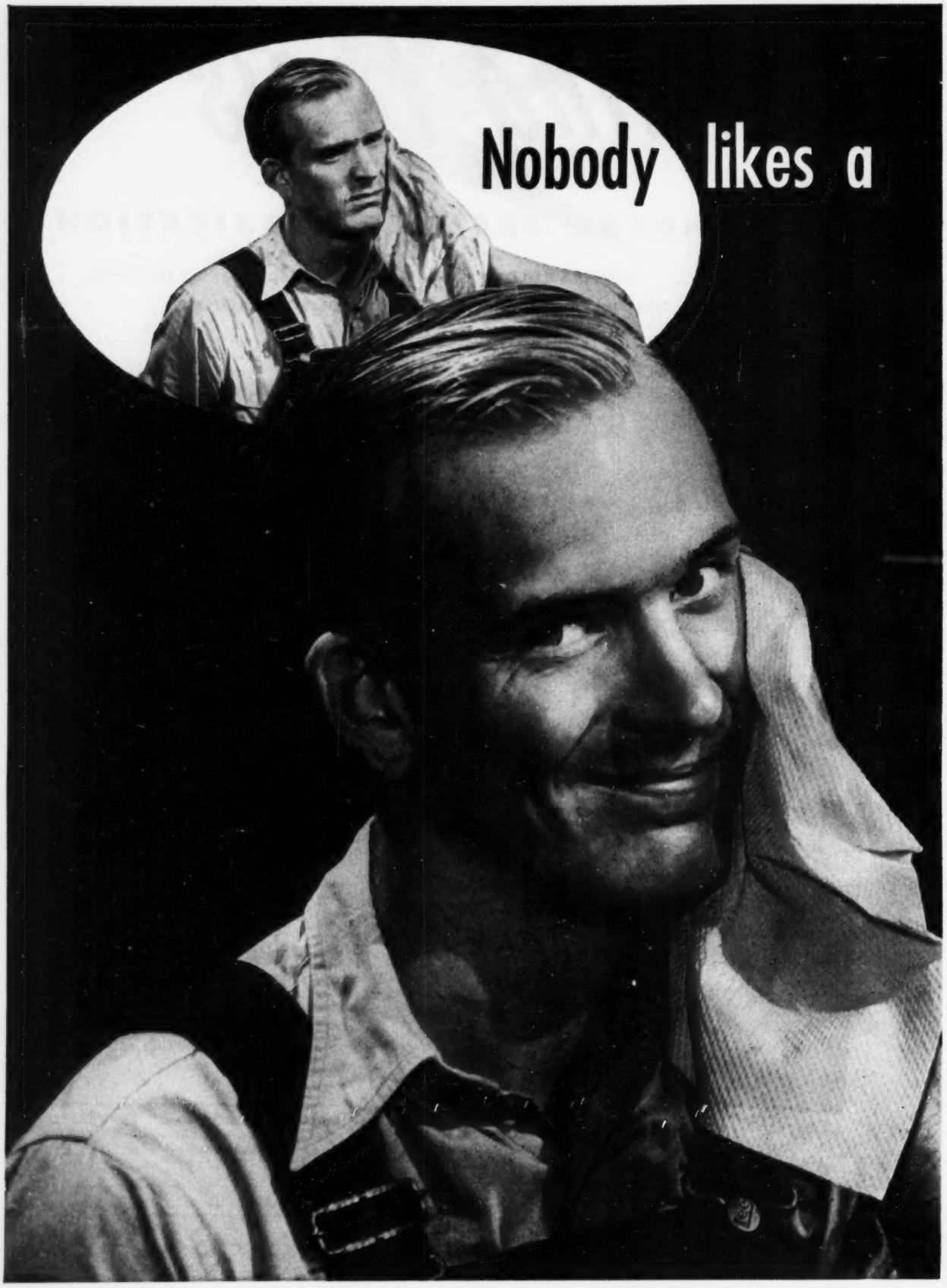
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Please send me full information on Scott Industrial Wipers.

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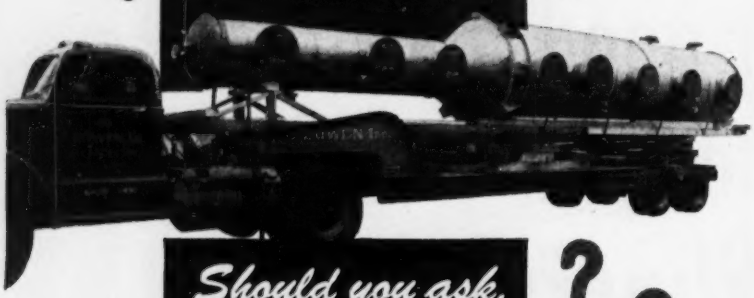
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THIS MONEL COLUMN Answers Two Questions

Should you ask,

"What kind of processing equipment do you make?," part of our answer would be to tell you about this column, an all-monel, one-piece unit.



Should you ask,

"Do you design to meet the customer's needs as well as fabricate to his specifications?," our answer would be, "Yes, we do both. We designed this column."

Our equipment design staff has an exceptionally broad understanding of processing and the part equipment plays in its many ramifications. Our shop men can point to many years of experience fabricating with all commercially used metals.

Thus, we can be of service in two ways:

1. Study your processing requirements and design the column, tower, tray, heat exchanger, retort or whatever equipment you require, check with your technical and operating men, then fabricate; or
2. Fabricate to your design specifications. In such cases, we always re-check dimensions, parts and choice of materials. Often, we have been able to suggest ways both to improve the design and to economize on fabrication.

This column comes under the first type of service. If either would fit into your equipment requirements, we'll be glad to discuss them with you.

Engineering and Manufacturing Process Equipment to Your Requirements

We have certain standardized specialties of our own design or which we licensed to manufacture and sell such as: sectional trays, sieve type trays, Socony-Vacuum UNIFLUX trays, Shell TURBOGRID tray; boiling caps, etc.; vapor compression stills; Badger Corrugated-Type Expansion Joints.

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THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers—and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

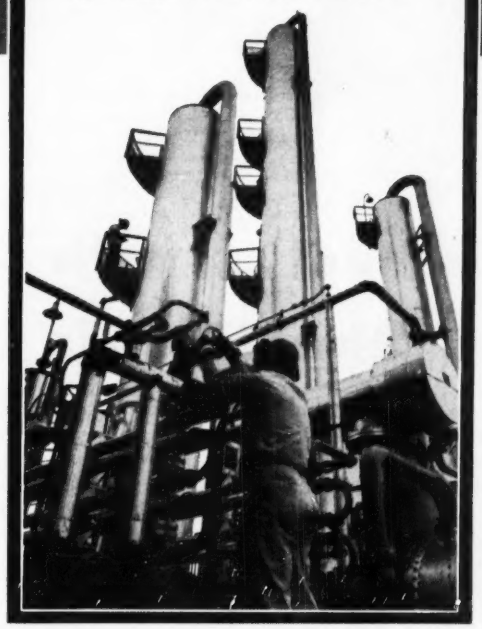
SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

McGRAW-HILL PUBLICATIONS

New Ethyl-Benzene Plant—straddles a salt marsh!



The Williams Plant at Port Arthur, Texas. This Ethyl-Benzene Plant was built on a salt marsh by Koppers Engineering and Construction Division.



NORMALLY, land that is under water isn't a good place for a plant site. Yet, at Port Arthur, Texas, there was a stretch of salt marsh that was ideal in every other respect.

So Koppers engineers were called into consultation. They were asked: "Could you possibly build a chemical plant on this swamp?" They *could* . . . and did.

The land was drained. Roads were built. Structures were supported on deep-driven pressure-creosoted wood piles (Even the smallest pump was placed on piles!)

Now, on land that was formerly useless, the Williams Plant is producing high-purity Ethyl-Benzene, proving that the best engineering skill can overcome the worst obstacles.

Put your design and construction problems—conventional or otherwise—in the capable hands of our engineering staff. Your inquiry is invited.

KOPPERS COMPANY, INC.

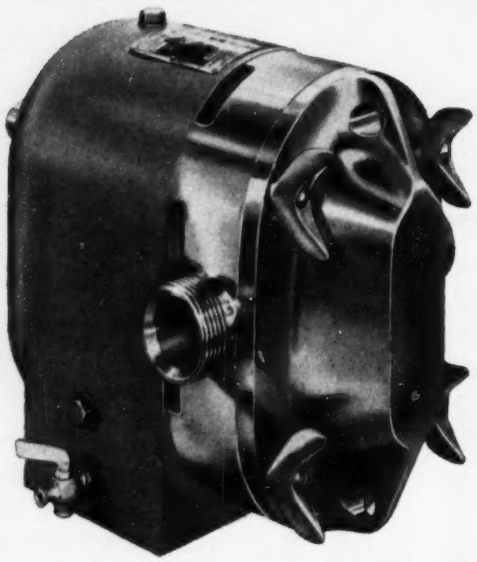
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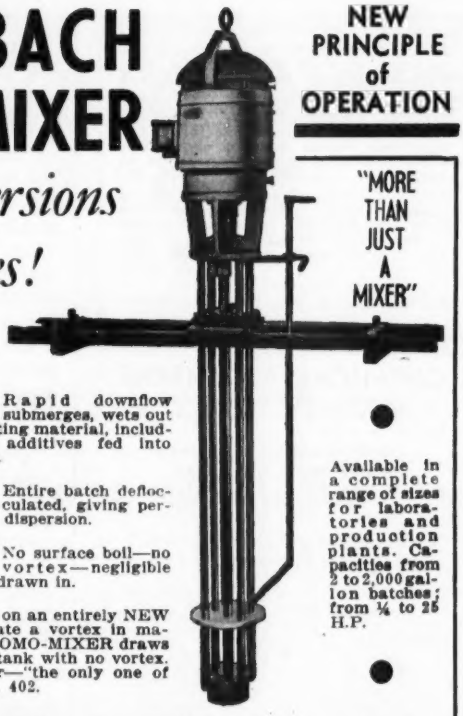
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NEW PRINCIPLE of OPERATION

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1. Turbine head near tank-bottom causes converging horizontal flow, carrying sedimentary material into close-fitting rotor vanes.

2. Inflowing "slurry" violently agitated at high velocity, projected up toward surface.

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This mixer is built and operates on an entirely NEW principle. Ordinary mixers create a vortex in material, pull air into tank. The HOMO-MIXER draws only from the BOTTOM of the tank with no vortex. Write for details of this mixer—"the only one of its kind". Ask for Catalog No. 402.

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EACH ISSUE

THIS WHERE TO BUY SECTION supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation in the process industries.

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You'll Find Metalweld Services A Sound Investment, Not An Expense!

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If you are interested and can initially meet the qualifications stated, please reply stating your present position, your education, a brief resumé of your experience since college and full personal statistics. You may be assured that your reply will be kept most confidential. It is of utmost importance to us to keep it so, too, and any interview resulting from your reply must be with that understanding.

P-3866, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

OPER. POWDERED METAL DEPT.

Here is a rare opportunity for a man qualified to operate a small powdered metal parts department.

He should have 5 years or more experience with technical background equivalent to a graduate engineer. His background should include tool & die experience with a thorough knowledge (precious metals) of fabrication and related metallurgy.

Must have ability to control quality & costs and recommend products to be manufactured. We want him to develop a small dept into a significant part of our business.

Forward complete details of your experience, training and salary requirements. All replies will be treated confidentially.

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Experienced Chemical or Mechanical Engineer wanted by leading chemical manufacturer located in Chicago. Prefer man between 25 and 35 years old with engineering experience in connection with chemical processing plants. Salary open.

Moving expenses will be paid. Your reply should contain your complete personal history, employment record and salary requirements. Send snapshot if available.

P-3926, Chemical Engineering
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SALES ENGINEER: Promotion makes possible outstanding opportunity for experienced young sales engineer. Midwest manufacturer of corrosion-proof process equipment for the Chemical, Steel and Electroplating Industry. To manage New York Sales Office. Send complete resume. P-3946, Chemical Engineering.

CHEMICAL ENGINEER, graduate of recognized school, to do process development production work in heavy chemicals by large Florida chemical manufacturer. Address reply to P. O. Box 3269, Tampa 1, Florida giving full details including education, experience, photograph (if available) and salary desired, in first letter.

QUALIFIED SALES Engineer—For Isocyanate program. Experience in plastics and polyesters preferred but not essential. Background in mixing, spraying and applying resinous systems desired. Training period for proper man. Eventual travel. Age under 30. Salary open. P-3790, Chemical Engineering.

DEVELOPMENT ENGINEER—Industrial Market Development Chemist or Chemical Engineer. Analytical type experienced in market development of new products and application of surface active chemicals. Membership in technical associations preferable. Travel eastern half of U. S. Under age 30. P-3793, Chemical Engineering.

WANTED: GRADUATE engineer, preferably Chemical for consulting and field sales work. Three or more years sales experience desirable but not essential. Young man preferred who can advance in fast growing concern serving process industry. Territory in South and Southeast. P-3860, Chemical Engineering.

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REPRESENTATION WANTED—Metropolitan New York Area. Well established manufacturers' agency desires to broaden their activities and are interested in additional representation. RW-3813, Chemical Engineering.

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SALARIED POSITIONS $5,000 to $35,000. We offer the original personal employment service (established 44 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars, R. W. Bixby, Inc., 653 Brisbane Bldg., Buffalo 3, N. Y.

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RA-2870, Chemical Engineering
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WANTED

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Division of Personnel
Knoxville or Chattanooga, Tennessee

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3—Majonnier S/S Vac. Pans, 3', 4', 6'.
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1—Oliver 6'x6' Rotary Filter, acid proof.

1—Day #30 Imperial dbl. sigma blade, jack. Mixer, 75 gal.

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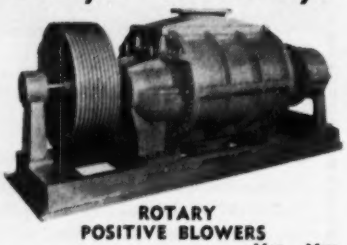
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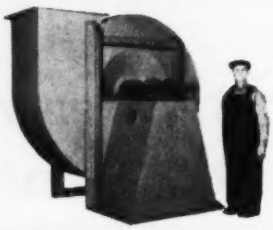
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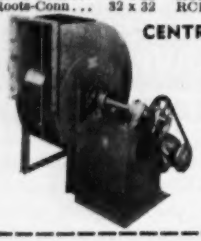
MAKE	SIZE	TYPE	Max. Press.	Max. CFM
Roots-Conn...	8 x 20	RCR	3.5	955
Sutorbilt.....	18 x 42	XB	4	5320
Roots-Conn...	22 x 36	RCD	5	5500
Roots-Conn...	67	AF	5	164
Roots-Conn...	14 x 36	RCR	5	3580
Roots-Conn...	16 x 24	RCD	5	2515
Roots-Conn...	10 x 18	RCD	6	805
Roots-Conn...	10 x 12	RCS	7	614
Roots-Conn...	76	AF	7	200
Sutorbilt.....	5H	Cal.	10	66
Sutorbilt.....	8H	Cal.	10	272
Roots-Conn...	10 x 10	RCR	10	616
Roots-Conn...	24 x 23	RCDH	7.5	8610
Roots-Conn...	32 x 32	RCDH	7.5	14950

TURBO BLOWERS

Stock No.	Make	Size	HP	Vol.	Press. -oz.
1601	General Blower	1630	30	3600	16
1529	Ingersoll Rand	FS377	150	15000	20
2415	Spencer	1515-H	15	1425	24
3220	Spencer	2020	20	1300	32
693	Allen Billmeyer	D-6	7½	275	48
1000	Spencer	Special	200	8200	48

STEEL PLATE EXHAUSTERS

MAKE	SIZE	TYPE	Wheel Diam.	Inlet Diam.
Sturtevant....	100	Des. 3	72¼	38
Sturtevant....	70	Des. 3	49¼	26
American.....	80	ELS	48¾	29¼
American.....	70	ELS	42⅛	25¼
American.....	55	ELS	36¼	23
Sturtevant....	50	Des. 3	36	19
New York.....	33	GI	33	21¼
Buffalo.....	45	MW	32	19¾
American.....	50	ELS	31	18¾
Gen .Blower...	45	MX	27	18¼
American.....	35	E	23	15
Sturtevant....	30	Des. 2	18	11
American.....	3	VRV	13	7
American.....	3	V	12	7



CENTRIFUGAL FANS

MAKE	SIZE	TYPE	Wheel Diam.	Inlet
American.....	11	FH	65¾	73¾
American.....	9	AHS	53⅜	61
Clarage.....	3¾	W	42¾	44
Bayley.....	8	I	40	41
New York.....	36	ME	36	39¼
Sturtevant....	6	Des. 3	27	27¾

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- 4 New Stokes vac. shelf driers model 138-H5—8 and 4 shelves
- 1 Baker-Perkins size 16 vac. jacketed mixer with explosion-proof motor Sigma Blades Type BB
- 3 Bird 40" suspended centrifuges 40-20 HP steel baffled, solid basket
- 3 Colton #5½T tablet machines Reeves drive 5 HP motors
- 1 Shriver 36" filter press, iron, closed delivery, 32 chambers plate and frame
- 5 Pfaudler 50 to 500 gal. glass-lined jacketed and agitated reactors
- 1 Sweetland #12 filter
- 1 Feinc 5' x 3' all monel vac. filter
- 1 500 gal. Baker Perkins unidor Jacketed Mixer
- 25 Aluminum condensers, 400 and 600 sq. ft.
- 1 Hersey 3' x 24' monel drier
- 1 Buflovac monel 1 and 2 effect evaporators
- 2 3000# steel jacketed ribbon blenders
- 1 4' stainless International conical blender, 25 cu. ft.
- 2 Plate fabricators 7500# dry powder mixers
- 1 Triple effect evaporator 154 sq. ft. per effect
- 5 Louisville de-watering presses
- 10 New Kingsford stainless 2" pumps
- 12 Philadelphia Foote Bros. Jones Nettco agitator drives —¾ to 25 HP
- 6 Devine, Beach-Russ, Stokes vac. pumps—15 to 196 CFM
- 1 JNM Baker Perkins 100 gal. Hydraulic tilt Jacketed Sigma blades, explosion proof motor & vacuum operation

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4—Reeves 7'x160', 7'x120' ⅝" shell.
1—Vulcan 8'x125', ¾" shell.
2—Allis Chalmers 9'x80', ⅝" shell.
1—Link Belt 7'x45', ½" shell.
1—F. L. Smidth 4'x30', ⅜" shell.
1—Allis Chalmers 6'x35' Rotary Dryer.
1—Vulcan 4½'x50' Rotary Dryer.
5—Link Belt Hersey Rotary Dryers 3'x24', 3'10"x16', 7'5"x20'.
4—Louisville Steam Tube Dryers 6'x50', 6'x30', 5'x28'.
6—Devine Vacuum Shelf Dryers with 20, 17, 14, 9, 6, and 4 shelves.
1—Stokes 30"x8', 3'x15' Rotary Vacs.
4—Buflovak double drum 60'x144", 42"x90", 36"x84", 32"x52".
1—Devine 2'x4' Vacuum Drum Dryer 316 S.S.
2—Buflovak 6' dia. Crystalizers.
1—Buflovak 6'6" dia. Vac. Crystallizer S.S.

FILTERS

2—Oliver Monel 8'x10' Rotary-Vacs.
2—Eimco 8'x8', 4'x4' Rotary Vac.
8—Oliver Rotary Vacuum 11'6"x18', 11'6"x 14', 8'x12', 8'x10', 8'x8', 8'x6', 3'x1'.
1—Swenson 4'x2' nickel Rotary Vac.
2—Sweetland #12 with 72 and 36 leaves.
1—Niagara #110-20 with 12 S.S. leaves.
1—Sparkler #33-S-17 steel filter.
1—Shriver 36" P&F 42 chambers.
4—Shriver 30" P&F 30 chambers.
8—Sperry 24" P&F 16 chambers.
2—Sperry Aluminum 30" and 24" P&F.
1—Sperry 36" P&F 4 eye, heresite coated.
2—Sweetland #3 all stainless, 12 leaves.
12—Filter Press Skeletons, all sizes.

CENTRIFUGALS

1—Bird 48" Suspended Monel.
1—Bird 40" Suspended 347 S.S.
2—Bird 40" Suspended, rubber covered.
1—AT&M 36" center slung, rubber covered.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
2—Tolhurst 30" center slung, steel.
2—Bird 32"x50", 18"x28" Continuous.
1—Sharples Nozljector DH-2, 304 S.S. 15 HP.
2—Sharples C-27, C-20 Stainless Steel Super-D-Hydrators.
2—Sharples #16P Monel and SS Super Centrifuges.

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6—Stainless Steel 8'x61'6", 7'x25'6", 6'x64', 6'x45', 4'x70', 2'x39'.
10—Steel 7'x5'x70', 7'6"x55'6", 7'x42', 6'x63', 5'x61'6", 4'x110', 4'x72', 3'6"x63', 2'6"x60', 2'x75'.

Complete Oxygen Plant rated at 175 tons per day 95.5% pure oxygen.

HEAT EXCHANGERS—CONDENSERS

2—1440 sq. ft. 304 S.S. 75# PSIG, 340°F.
3—1345 sq. ft. steel, 70# PSIG, 300°F.
2—1125 sq. ft. steel, 850# PSIG, 900°F.
9—Kettle type reboilers, steel & SS, 1250, 1125, 750, 660, 400 & 340 sq. ft.
58—Atmospheric heat echanger units, 304 S.S., 715, 477, 358 & 108 sq. ft.

OTHER ITEMS

1—Union Boiler 300 HP, 200# W.P.
2—Oliver 8'x10' Monel, Rot. Vac. Filters.
2—10,000 gal. steel welded Pressure Tanks 175# PSIG.
10—6'x30' ASME Horizontal Storage Tanks, 75# pressure.
4—IR 24" Centrifugal Pumps 8000 GPM Engine operated.
90—Centrifugal Pumps 1½"x1" to 8"x6" steel and stainless steel.
3—I.R. Propane Compressors steam driven 5410# per hr.
2—Clark Bros. gas Engines 4100 CFM model MA-4 150 BHP.
3—High Pressure Furnaces Natural gas fired, 2½ to 15 million BTU per hr.
1—Blaw Knox 13,000 gal. steel welded Pressure Tank 200 PSI.

NEW COMPRESSORS

2—Ingersoll-Rand Air Compressors 3580 CFM, 110 PSI, Type PRE-2, size 30"x 18"x22", 200 RPM with I.R. Class 1210-HM-2 Aftercooler with condensate traps, control, 600 HP G.E. Synchronous motor, exciter and panel.

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Contact us for your fabricating work from single items to complete plants. We specialize in construction of all types of Tanks, Kettles, Reactors, Condensers, Evaporators, Stills, etc., in all metals in accordance with ASME and API Codes. We also can rebuild your present equipment.

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1—Devine 5'x10' steel, jacketed Mill.
3—Abbe 6'x10' porcelain lined, jacketed, Pebble Mills.
2—Raymond 3 and 5 Roll High Side Mills.
4—Hardinge Mills 4½'x16", 5'x22", 5'x36", 6'x22", 10'x48".
6—Patterson 6'x8', 5'x6', 4'x5', 2½'x3½', brick-lined Pebble Mills.
5—Abbe 3'x4', 3'x3½' Pebble Mills.
2—Premier Colloid Mills 8" dia., S.S.
1—Jeffrey 30"x24" Hammer Mill, Type A.
3—Raymond, Gayco Separators 12', 8', 6'.
4—Mikro Pulverizers, #2TH, #1SH, #1SI and Bantam.

SCREENS

1—Day #81 single deck 40"x120".
1—Patterson single deck 40"x84" S.S.
1—#42 Rotex double deck 40'x84".
1—#11 Rotex single deck 20"x48".
1—#23 Rotex three deck 20"x80".
4—Tyler Hummer 4'x15', 4'x10', 4'x5' single deck with V-16 Vibrators.

MIXERS

4—Baker Perkins 300, 100, 50 and 1 gal. sigma blades, jacketed, steel and S.S.
1—Baker Perkins 50 gal. JEM, 50 HP.
4—Baker Perkins, 2 gallon, stainless steel, Sigma Blades.
1—Robinson 4000# steel powder.
8—Rodgers 400 to 3000# powder.
4—Simpson Intensive Mixers #40.
8—New Portable Agitators ¼ 5 HP.
4—Day, Ross 8 and 50 gal. Pony.

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1—Pfaudler 500 gal. glass lined, jacketed, agitated Reactor.
2—Blaw Knox 800 gal. S.S. agitated Reactors 100# int. press.
6—Evaporators, single and multi-effect 300 to 14,000 sq. ft.
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5—Buflovak Condensers 20 to 90 sq. ft.
2—Groen 125 gal. S.S. jktd., agitated Kettles.
1—2800 gal. 316 S.S. Tank with coils.
3—2300 and 1400 gal. Aluminum Tanks.
6—Glass-lined Storage Tanks 6000 and 8000.

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7—Stokes Vacuum Pumps 10 to 100 CFM.
6—Stokes R, D3, B2, F, Tablet Machines.
1—Kux Rotary Tablet Press Model 15-25.
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4—Olivite, Duriron rubber and stainless steel Centrifugal Pumps 1" to 6".

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Triangle Elec-Tri-Pak G2C, A6CA, N1C, A3A Fillers.

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2—Hardinge Conical Ball Mills 6'x22".
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20—Jacketed Kettles—Stainless, Copper, Aluminum.
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1—Robbins Vibrex 3x6 Vibrating Screen, single deck.
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60—New Pressure Cookers, 18"x16" & 24"x28".
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1—Jeffrey Vibrating Conveyor 13' lg. 12" wide.
1—Buflovak Jacketed Impregnating Tank 42"x52".
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1—Ribbon type Mixer, steam jacketed.
2—Buflovak Double Drum Dryers 32"x80".
2—Nash Air Compressors, Type AL-623.
1—Manton Gaulin Stainless Homogenizer, 125 gph.
1—Shriver 18" Aluminum Filter 9-plates 9-frames.
1—Rotary Dryer direct fired 54"x30'6".
1—Kennedy-Van Saun Rotary Dryer, 4'x40'.
Davenport Rotary Steam Tube Dryer, 6'x36'.
1—Gruendler Hammer Mill, 10 H. P.—new.
2—Ransome Rotating Drum Mixers 9' dia. x 11'x6".
1—#316 stainless Reactor, 265 gals. cap. Jacketed.
Abbe Pebble & Tube Mill, 5'x22'—Burr-Stone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill 42"x36" jacketed.
3—Dopp Kettles with agitators, 600 gal. cap.
1—Sparkler S.S. Filter 18-D-6.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer #20, with 2 motors 10 HP each.
Robinson Ribbon Type Mixer, 30"x10'—like new.
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HAMMER MILLS—Wms. Reg. #1—8x14 & GA 30, 24x30 (125 HP).
BALL MILLS—5½x22. manganese liners, 200 HP Synchronous motors.
HARDINGE MILLS—3'x8"—5'x36" (w/classifier), 6'x22"—7'x48"—10'x48"—all with motor drives.
MIXERS—Robinson Double trough 15"x10', W & P 50 gallon double sigma, Simpson #1½—Lancaster 4½ EAG w/motors.
PULVERIZER—Sturtevant #1 Ring Roll w/25 HP motor.
PEBBLE MILL—4 gallon lab.—100-225 (one new) and 1600 gal. porcelain lined.
NASH HYTOR VACUUM PUMPS—MD 673—MD 623—H 5 all with motors.
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Pfaudler 10 gal. Jkt. glass lined reactor, agitated
Proctor & Schwartz Dryer, Gas Fired, 100' long
Automatic Large Tube, Crimper & Closer
S. S. Tanks 50 to 10,000 gal. agitation avail.
Boilers 2 h.p. to 1000 h.p. Oil or Gas Fired
Mikro Pulverizer 4-TH with extra screens
Lehman 8-roll Mill 12" x 30" water cooled
Tolhurst 48" Centrifuge
Laughlin Continuous Filter
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Proctor and Schwartz 84 tray dryer, and 5, 48 trays
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1—Alloy Fabricators Stainless Steel Jacketed Vacuum Reactor, 30 gal. with agitator.
1—Type 347 Stainless Steel Storage Tank, 1500 gal.
1—Patterson Kelly Stainless Steel Jacketed Autoclave, 50 gal. cap. 200# Internal Pressure.
1—Patterson Stainless Steel Vacuum Reactor, 50 gal.
1—1600 gal. Type 347 Stainless Steel Storage Tank.
1—Type 316 Stainless Steel Storage Tank with coil, 3,000 gal.
1—Stainless Steel Jacketed Kettle, 2,800 gal. capacity.
1—Vertical Storage Tank, 10,000 gal. capacity, 125 psi.
2—Haveg Storage Tanks, 2,000 gallons each.
1—Combustion Engineering Stainless Steel Jacketed Autoclave, 500 Gals, 300 PSI.
1—Struthers Wells Steel Jacketed Vacuum Reactor, 1800 Gals. Cap. with Drive, Turbine Agitator & Coils.
12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Each.

CENTRIFUGALS

1—DeLaval Type 316 Stainless Steel Multi-Matic Centrifuge.
1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
2—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Baskets.
1—Sharples Type 316 S.S. Super-D-Hydrator, Model No. C-20.

DRYERS—KILNS

1—Buflovak Type 347 Stainless Steel Rotary Vacuum Dryer, 5' x 20'.
1—Link Belt Steel Roto Louvre Dryers, 7½' x 20'.

DRYERS—KILNS

3—Devine Single Door Vacuum Shelf Dryers, 5-10 shelves.
1—Stokes Rotary Vacuum Dryer, 3' x 12'.
1—Vulcan Rotary Kiln, 7' x 120'.
1—Louisville Experimental Laboratory Dryer, 12" x 7½'.
1—Devine #A Laboratory Vacuum Shelf Dryer with 3 Stainless Steel shelves.

FILTERS

2—Feinc Type 316 Stainless Steel Rotary Vacuum String Discharge Filters complete. NEW.
10—Shriver & Sperry Plate and Frame Filter Presses from 12" to 42".
1—Sweetland #2 Stainless Steel Filter.
1—Sparkler Type 316 Stainless Steel Filter Model 33 D 7.
1—Bird Young Filter, 4' x 2'.

MIXERS

1—Gemco Double Cone 7½' Blender.
6—Simpson Intensive Mixers #0 and #1.
1—Patterson Stainless Steel Double Arm sigma blade Mixer, 2½ gal.
4—Baker-Perkins Double Arm Jacketed Sigma Blade Mixers, 100 gal. capacity.
1—J. H. Day Stainless Steel Double Arm Jacketed Sigma Blades Mixer, 150 gal. capacity.
1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 Gals.
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1—Struthers Wells Double Arm "Northmaster" Mixer, 50 Gals. Working Cap., 100 Gals. Total Cap.

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1—Devine Double Door Vacuum Shelf Dryer, 13 Shelves.

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1—Bauer Attrition Mills with 25 HP motors.
1—Abbe #00 Rotary Cutter with 3 HP Motor.
1—Mikro #2TH Stainless Steel Pulverizer.
1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
1—Mikro #3W Pulverizer.

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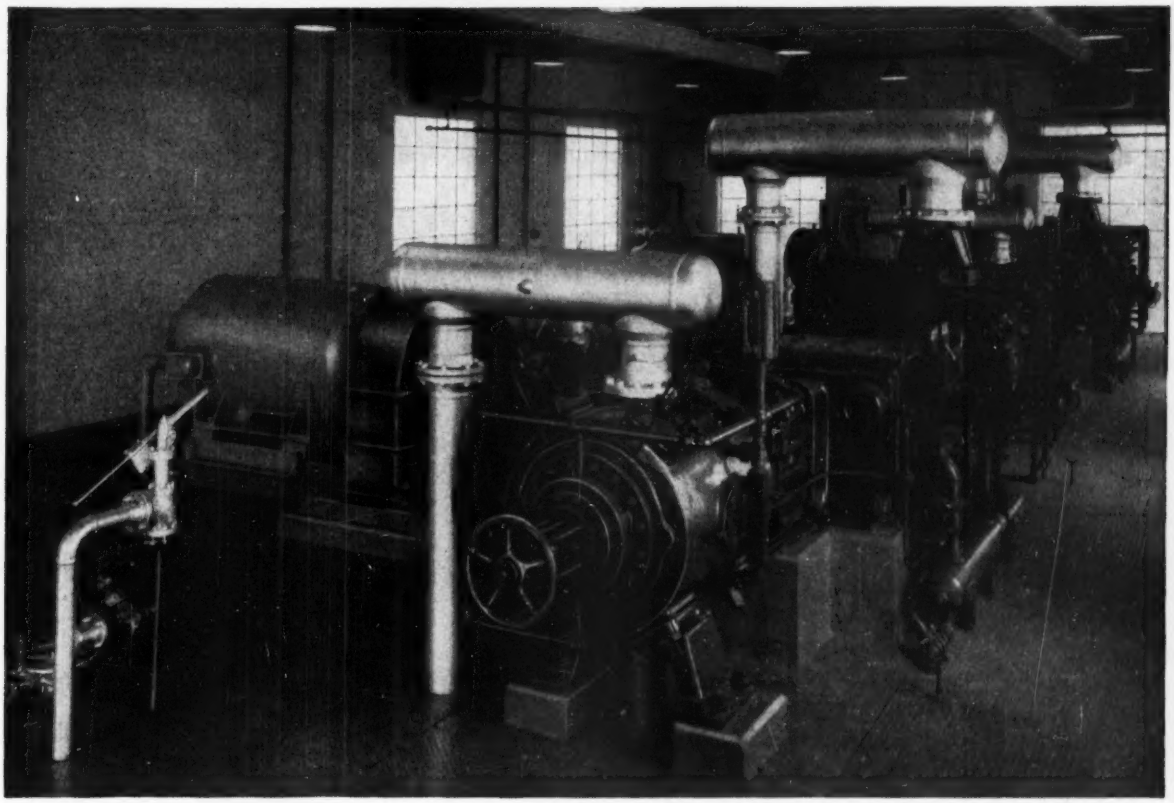
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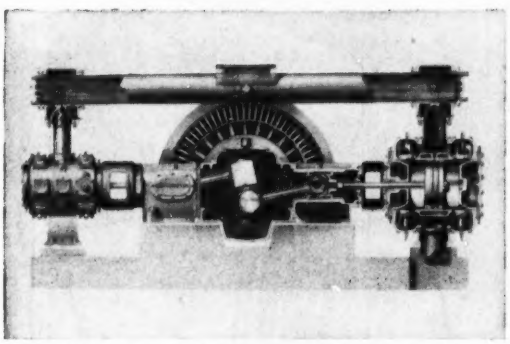
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LINEUP OF WORTHINGTON 2-cylinder gas compressors at Frontier Oil's new Tonawanda (N.Y.) refinery. Units are rated at 600 hp each.

Frontier's new refinery gets Worthington compressors



CUTAWAY VIEW of Worthington balanced-opposed compressor. Note low silhouette, modest foundation requirements, and double-throw crankshaft which permits as many as four pairs of cylinders to be arranged on single compressor frame.

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Remember, no matter what your capacity or pressure requirements may be, there's a compact Worthington steam- or motor-driven compressor to fill the bill. Write Worthington Corporation, Compressor Division, Section K.3.5, Buffalo, N.Y. K.3.5

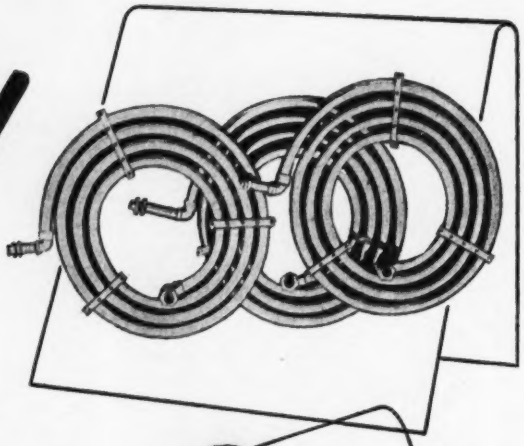
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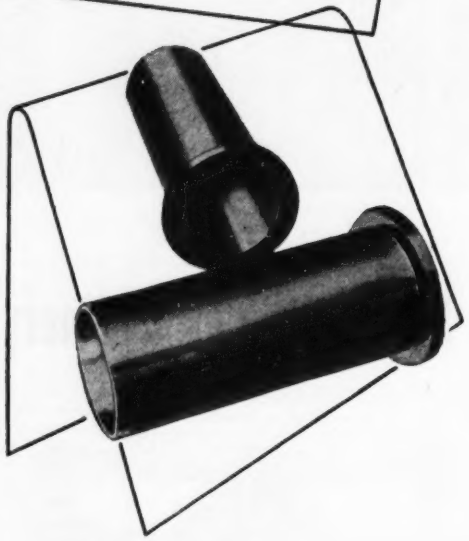
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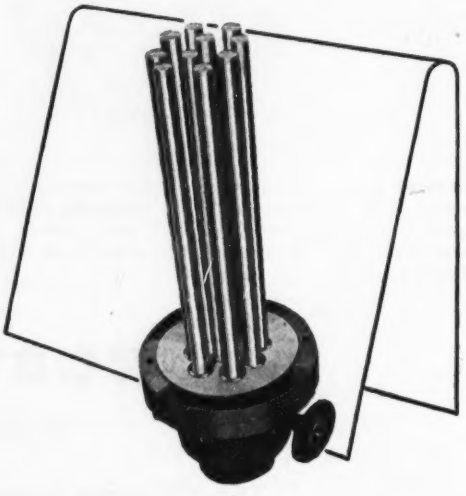


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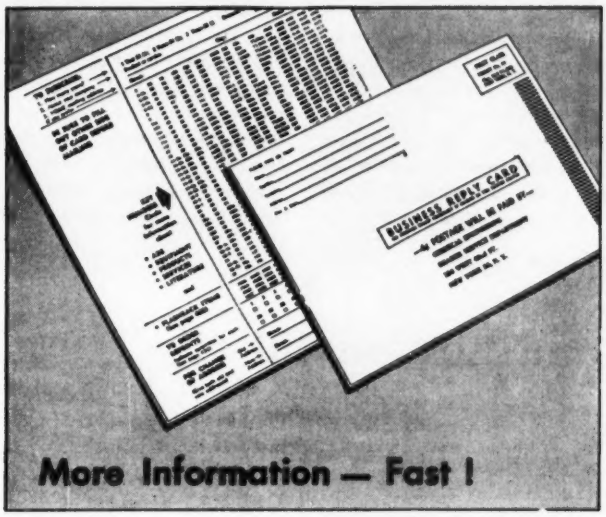




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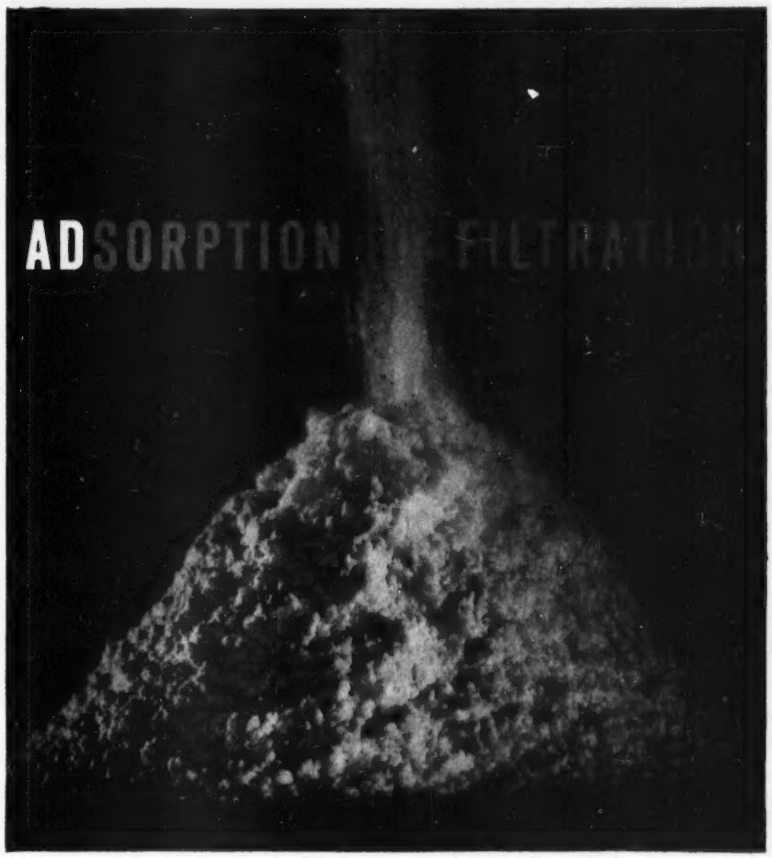
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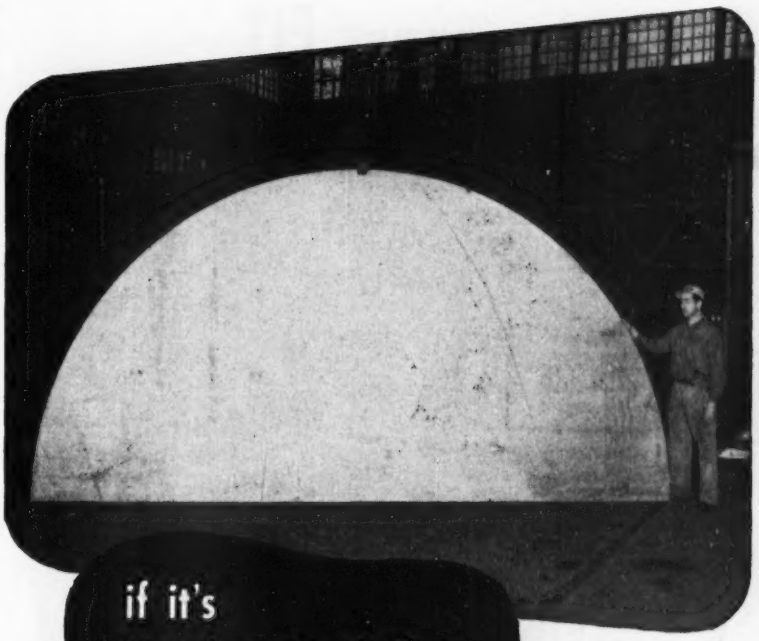
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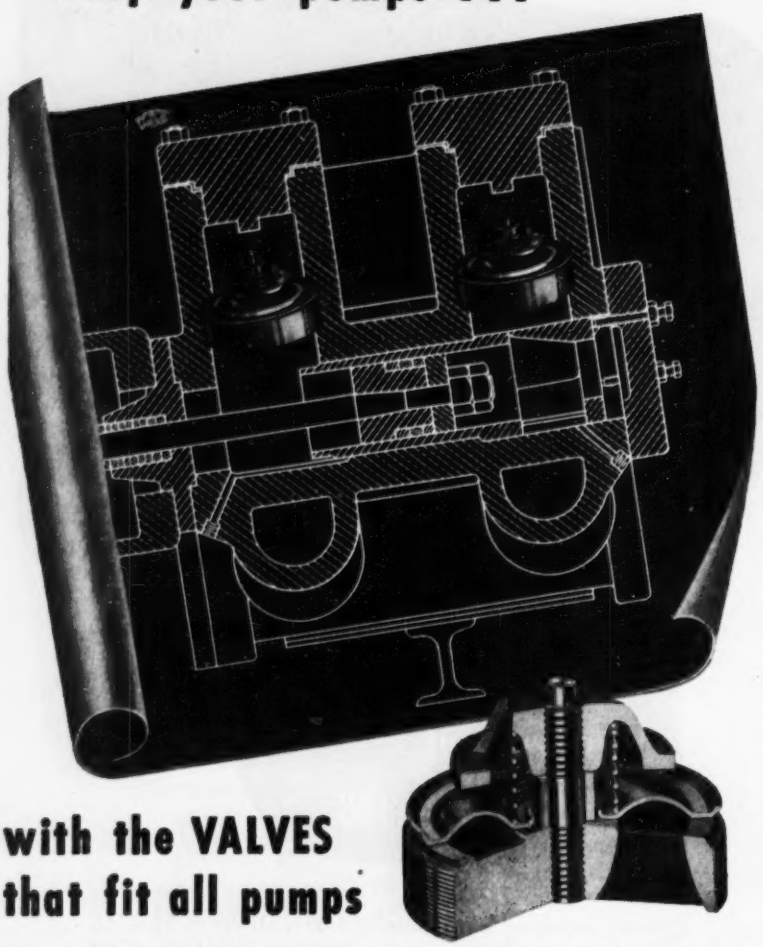
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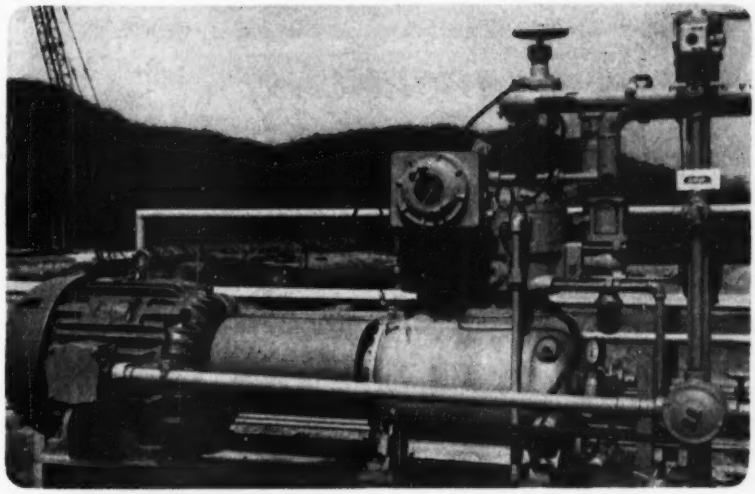
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Pumping Propane With a Frick "ECLIPSE" Compressor

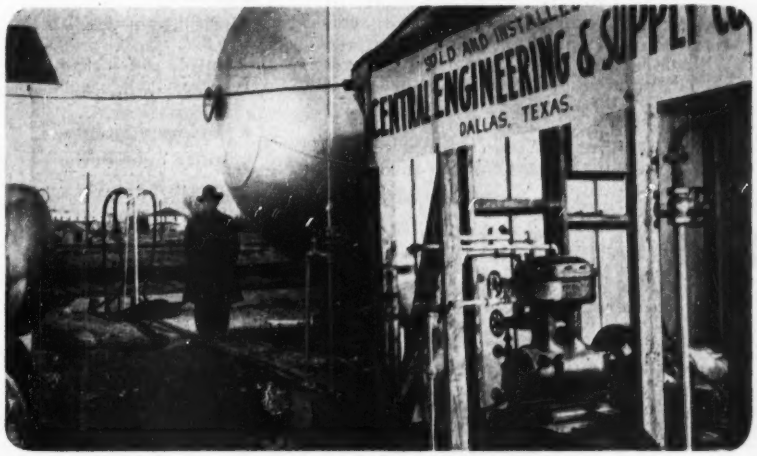
The Tennessee Eastman Company, at Kingsport, uses this 3-cylinder Frick compressor in transferring propane from tank cars to the storage tanks shown in the background. Explosion-proof controls were furnished for this exacting service.

Many Frick compressors are used for transferring ammonia, also for handling carbon dioxide, ethylene, and other gases.

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Below: Frick compressor transferring ammonia at the Frisco (Texas) Fertilizer Co.

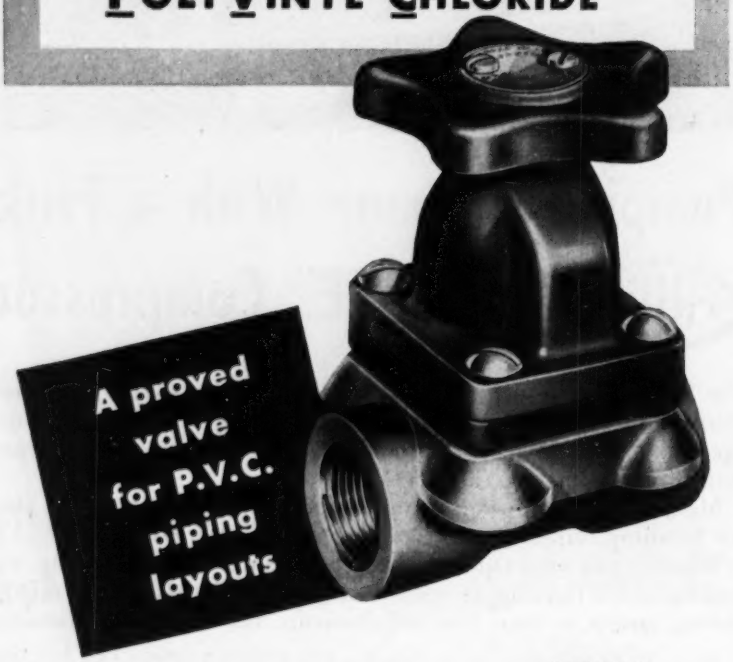


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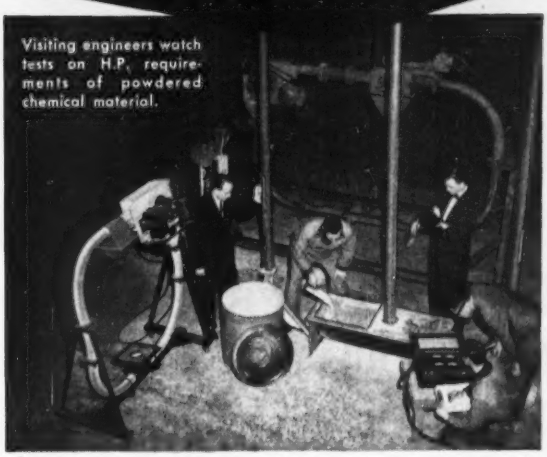
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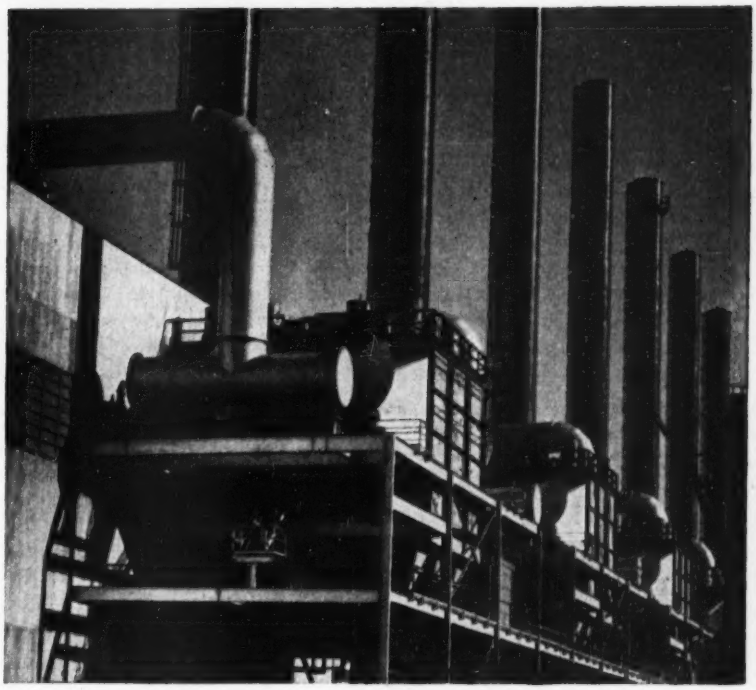
To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and services featured last month in New Equipment and New Products. Use the postcard (p. 497) for more information on any item.

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Your Guide to Technical Literature Now Available

What It Contains . . .

This is a comprehensive listing of the latest literature you can now get from manufacturers on chemicals, equipment and services in all fields of interest to chemical engineers. It lists new publications just issued as well as all bulletins mentioned in this issue. For your convenience, all items have been categorized and alphabetized.

For More Information . . .

You can get — and get fast — more information on any publication listed in this guide by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

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Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours—free—for the asking.

Chemicals

Absorbers, Ultraviolet Light.....Convert ultraviolet radiations to invisible or infra-red radiation. Used in protective coatings or incorporated directly in plastics—they act as effective, transparent sun-shield.
476A American Cyanamid Co.

Acetyl Peroxide.....A safe method of isolation of acetyl peroxide. Relatively pure acetyl peroxide may be isolated from its commercial solvent solution by vacuum distillation. For complete data refer to Bulletin 28.
476B Buffalo Electro-Chem. Co.

Acid, Boric.....Technical Bulletin provides complete information. Includes theoretical composition, solubility in water, chemical specifications, typical screen analysis, industrial end uses, etc. Request No. 3.
476C Pacific Coast Borax Co.

Acid, Citric.....Important chemical in many metal cleaning pastes & liquid formulations for both home & industrial use. Data in bulletin, "Ammonium Citrate & Citric Acid in Scale & Rust Removal." No. 15.
436a Chas. Pfizer & Co.

Acid, Dichloroacetic.....A strong organic acid—undergoes the normal reactions of such acids. Announces the availability of a Technical Bulletin covering Kay-Fries specifications, typical reactions, etc.
476D Kay-Fries Chem.

Acid, Oxalic.....Because Pfizer oxalic acid solubilizes iron oxide, it is chief ingredient in radiator cleaning compounds. Company makes available complete information in detailed Technical Bulletin No. 34.
436b Chas. Pfizer & Co.

Acid, Peracetic (40%).....Chemical and physical properties of peracetic acid are discussed and examples of typical reactions and uses given. Other data pertains to precautions in handling material. Bulletin 4.
476E Buffalo Electro-Chem. Co.

Additives, Borate.....Adaptable for use with coating grade polyvinyl acetate to develop inexpensive washable fire resistant qualities in insulating and wallboard coatings for industrial and non-industrial uses.
476F American Potash & Chem. Corp.

Alcohol, Furfuryl.....Derived from agricultural residues and useful in the manufacture of a wide variety of products which include resinous mortars, cements, binder resins, textiles, etc. Bulletin No. 205.
374 Quaker Oats Co.

Borax, Anhydrous.....A product resulting from dehydration of the normal hydrated sodium tetraborate. Technical Bulletin covers theoretical composition, representative chemical analysis, uses, etc. Request No. 10.
476G Pacific Coast Borax Co.

Borax Glass.....Resembles ordinary glass in appearance—melts quietly without intumescence or frothing. Technical Bulletin covers composition (theoretical) representative chemical analysis, uses, etc. Request No. 2.
476H Pacific Coast Borax Co.

Catalysts, Platinum Metals.....In many procedures, production control, purity of end products & cost of catalysis are brought to peak efficiency thru use of one of the platinum metals catalysts. Uses & forms.
311 Baker & Co.

Chemicals, Industrial.....Description & typical applications for: alumina, calcined; alumina hydrate; aluminum sulfate; calcium hypochlorite; carbon tetrachloride; muriatic acid; nitric acid; caustic soda; etc.
476I Pennsylvania Salt Mfg. Co.

Chemicals, Process.....Valuable letter-size Folder keeps process chemical information handy. Contains availability charts of light metal compounds, heavy metal compounds, acids, etc., and full price schedules.
108-9 J. T. Baker Chem. Co.

Chemicals, Rubber.....31 p. covers uses, grades, properties, container information for tetramethylthiuram disulfide, tetraethylthiuram disulfide, selenium diethyldithiocarbamate, zinc dimethyldithiocarbamate, etc.
476J Sharples Chem.

Chemicals, Synthetic Organic.....Offers 12 p. Catalog covering descriptions and suggested uses for line of alcohols, esters, chlorine compounds, amines, ureas, dithiocarbamic acid derivatives, etc. No. 53-2.
476K Sharples Chem.

Chlorine.....Offers valuable technical bulletins: #7—"Liquid Chlorine"; #8—"Alkalies & Chlorine in Treatment of Municipal & Industrial Water"; #11—"Water Analysis"; #14—"Chlorine Bleach Solutions."
149a Solvay Process Div.

Chlorine, Liquid.....Presents new 72 p. technical and engineering service bulletin, "The Analysis of Liquid Chlorine and Bleach." Literature contains valuable data, tables, charts and indexes. No. 12.
149b Solvay Process Div.

Cyclopentane Derivatives.....Essential and detailed information on company's line of cyclopentane derivatives . . . for the pharmaceutical, perfume, and allied industries. Also furnishes samples and quotations.
476L Arapahoe Chem.

Defoamers.....For more efficient foam control. Versatile defoamers save space now wasted on foam, cut the processing time, eliminate waste & fire hazard of overflowing foam, etc. Offers complete information.
K445 Dow Corning Corp.

o-Dianisidine.....Company makes available upon request a free sample of o-Dianisidine—a gray to pinkish gray solid readily soluble in dilute hydrochloric acid. It may contain up to 0.5% ash as an impurity.
476M E. I. du Pont de Nemours.

Dicalcium Phosphate.....Quality and uniformity assured by chemical control from mines to finished products . . . service assured by large-scale production. Company offers Data Sheet with complete information.
476N American Agricultural Chem.

Dispersants.....More effective and considerably more economical to use. Are completely soluble in water . . . non-hygroscopic, non-fermenting, non-caking, free-flowing powders. Offers information in File 310.
476O Marathon Corp.

Eicosane, Technical.....Provides valuable information on Atlantic Technical Eicosane—a water-white, hydrocarbon mixture that is readily chlorinated to present to you a product of outstanding stability.
476P Atlantic Refining Co.

Ethyl Bromide.....One of Dow's numerous intermediates . . . helps make chemical synthesis easier and is usefully applied from laboratory to full-scale production. Offers detailed data and an experimental sample.
476Q Dow Chem. Co.

Fumigants, Grain & Mill.....Effective in fighting insect losses in grain elevators, farm storage, warehouses, etc. Describes active ingredients, properties, dosages, exposure time, flammability, in Bulletin 806 R.
477A Westvaco Chem. Div.

Hydrazine.....In addition to its use in fluxes . . . hydrazine is an important component of plant growth regulators, and an effective scavenger of oxygen from boiler feed water. Company offers the latest information.
477B Mathieson Chem. Corp.

Hydrogen Peroxide.....Hydrogen peroxide bleaching of chemical & mechanical pulps. New developments & process applications covered on basis of commercial & experimental data. Tables, graphs, flow sheets. Bulletin 32.
477C Buffalo Electro-Chem. Co.

Intermediates.....Individualized intermediates for organic synthesis. Company provides complete information with regard to specifications, description, properties in booklet, "Individualized Intermediates."
477D Michigan Chem. Corp.

Latices, Vinyl.....Properties and characteristics of company's Geon vinyl latices—which are summarized on a new available chart—offer you many opportunities for profit through new and improved products.
477E B. F. Goodrich Chem. Co.

Methocel.....This uniform, synthetic gum forms water-soluble films & coatings that resist most greases, oils & waxes . . . improves many products from capsules to paper sizings. Sample & comprehensive information.
477F Dow Chem. Co.

Methyl Chloride.....18 years of methyl chloride experience is available to help you do a more efficient methylating job. Immediate shipment in any quantities from laboratory cylinders to tank car lots. Full data.
477G Ansul Chem. Co.

Molybdenum Disulfide....."Lubrication Properties and Industrial Applications of Pure Molybdenum Disulfide," reprint of a 4 p. well-illustrated technical paper has been made available to all those interested.
477H Alpha Corp.

Peracids, Aliphatic.....Analysis of aliphatic peracids—description of new method based on use of ceric sulfate as a titrant for H_2O_2 present, followed by iodometric determination of peracid present. Bulletin 24.
477I Buffalo Electro-Chem. Co.

Peroxides, Alkaline Earth Metal.....Descriptive Bulletin contains valuable information on chemical and physical properties, uses and handling of calcium peroxide, zinc peroxide, and magnesium peroxide. No. 7.
477J Buffalo Electro-Chem. Co.

m-Phenylenediamine. . . . . .An amber brown solid soluble in alcohol, ether & water. Up to 1.5% of ortho isomer may be present as impurities. Water insolubles are below 0.2%; ash, below 0.1%. Provides free sample.
477K E. I. du Pont de Nemours

Plasticizers.....Booklet offers complete information on line of plasticizers. Covers specifications, properties, typical uses for dimethyl phthalate, diethyl phthalate, dibutyl phthalate, triacetin, tributyrin, etc.
477L Eastman Chem. Products.

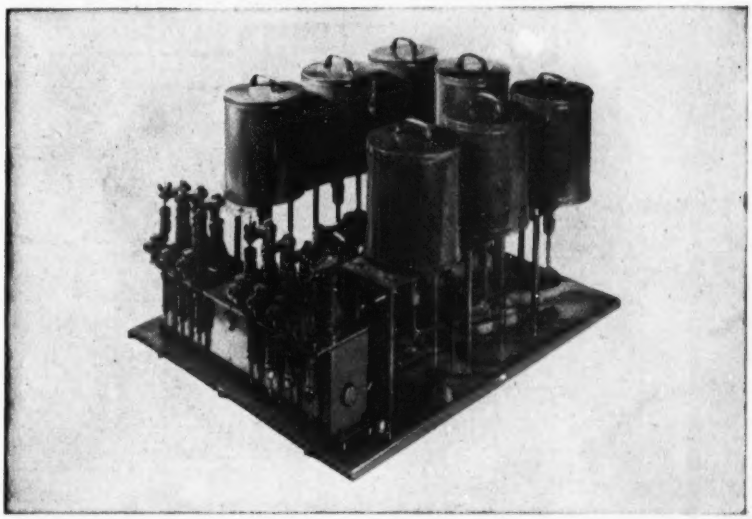
Plasticizers.....Offer valuable features: excellent heat and light stability; outstanding low temperature flexibility; low water extraction; unusually low volatility; etc. Details in a new Plasticizer Booklet.
477M Emery Industries.

Polypropylene Glycols.....Issues a new Technical Bulletin on polypropylene glycols. Physical properties, specifications, and shipping information are included for series: 150, 425, 1025, and 2025. No. F-7220A.
477N Carbide & Carbon Chem. Co.

Is Foam Troubling You?



MANZEL CHEMICAL FEEDERS CAN STOP IT!



✱ In chemical processes where foaming is a problem, Manzel engineers have a record of successfully eliminating it through the use of Manzel Chemical Feeders. There are models of large and small capacity—for simultaneously feeding many different chemicals at rates from a few drops to 60 gph per feed. They are easily synchronized with any process — supremely accurate and dependable in service.

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The Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame . . . maintains required temperature using either fuel . . . radiates heat uniformly without tube impingement. With the Tandem Unit's clean flame, a cold furnace can be brought to full capacity in a shorter time.

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

LITERATURE . . .

Potassium Tetraborate.....Technical Bulletin furnishes details on theoretical composition, physical & chemical properties, stability, solubility in water, representative chemical anaylsis, etc. Request No. 13.
478A Pacific Coast Borax Co.

Resins.....Provides valuable information on line of phenolic, vinyl, styrene resins for coatings in descriptive booklet, "Bakelite Resin Coatings for General Industry." Covers data on numerous applications.
93 Bakelite Co.

Rosin Amine Derivatives.....Numerous new opportunities for product improvements are offered by Hercules' group of water-soluble rosin amine derivatives. Full data on water-soluble, oil-soluble & acid-soluble types.
478B Hercules Powder Co.

Sodium m-Borate.....Technical Bulletin presents valuable data on composition (theoretical), solubility, alkalinity, representative chemical analysis, typical screen analysis, many uses, etc. Request No. 7.
478C Pacific Coast Borax Co.

Solvents.....Announces a new solvent for decarbonizing and paint stripping. Technical Data Sheet covers complete description, function, method of control, outstanding characteristics, method of handling and use, etc.
478D Curran Corp.

Solvents.....Available in a wide range of evaporation rates . . . offer the precise characteristics to meet your most exacting requirements. Presents complete information on the characteristics and specifications.
478E Esso Standard Oil Co.

Stannous Chloride.....A stable, anhydrous material . . . does not deteriorate with age—permits low-cost large-quantity purchasing. Solutions can be stored for long periods of time without clouding. Complete data.
478F Metal & Thermit Corp.

Sulphur Dioxide.....For processes requiring a superior reducing or bleaching agent, preservative, antichlor, pH control, or neutralizer. Provides samples, specifications and gives complete information.
L420 Tennessee Corp.

Surfactants, Nonionic.....Covers advantages of new "plus" features: water-white appearance; noticeable lack of odor; non-stratifying liquid; sediment-free. New Booklet offers complete data on surfactants.
478G Antara Chem.

Thioureas.....Makes available a Report on the use of diethylthiourea and dibutylthiourea for inhibition of HCl, H_2SO_4, HF, H_3PO_4, $(COOH)_2$ and CO_2-brine and H_2S-brine systems. Request Sharples Report 53-3.
478H Sharples Chem.

o-Tolidine.....A light tan solid soluble in alcohol, ether and dilute hydrochloric acid. It may contain up to 0.3% ash and traces of insolubles in 10% hydrochloric acid as impurities. Makes available free sample.
478I E. I. du Pont de Nemours.

2, 4-Tolylenediamine.....A light tan to brown crystalline solid, very soluble in alcohol, ether and boiling water. It may contain up to 0.1% water insolubles and 0.2% ash as impurities. Company offers a free sample.
478J E. I. du Pont de Nemours.

Trimethyl Borate.....A Technical Data Sheet is now available which covers: molecular weight; % boron, B; density; boiling point; flash point; color; solubility in organic solvents; etc. Request No. 1/OB.
478K Pacific Coast Borax Co.

p-Xylene 95%.....Important chemical may be oxidized to terephthalic acid, a new dibasic acid useful as chemical intermediate and in the production of polyesters, polyamides and other high polymers. Complete data.
478L Oronite Chem. Co.

Process Equipment

Autoclave-Reactors.....Makes available engineering knowledge, fabricating skill, facilities . . . for greater reliability. In any capacity, for any pressure, temperature or reaction. Details in Catalog No. 2413.
95 Blaw-Knox Co.

Blenders, Dry Batch.....Offers numerous features: 4-way mixing action speeds production—assures thorough blends; "open-door" accessibility permits easy, fast, thorough cleaning; etc. Presents detailed Bulletin.
300a Sturtevant Mill Co.

Blenders, Twin Shell.....More thorough blending in fraction of the time previously taken. One blender replaces methods which required a separate drum for every mix. Offers descriptive Catalog No. 12.
107 Patterson-Kelley Co.

Centrifugals, Continuous.....Illustrated Bulletin describes application of continuous centrifugal filters, listing 75 materials on which they are successfully used, with specific examples of performance.
479A Bird Mach. Co.

Centrifugals, Suspended.....Presents detailed information upon request covering company line of Suspended Centrifugals with Gyro-Balanced suspension head, and optional unloading and time control equipment.
479B Bird Mach. Co.

Centrifuges.....Provides industry with 7 types of continuous centrifuges to handle materials ranging from 2 immiscible liquids to crystalline solids. Briefly & graphically describes full line in Bulletin 1259.
137 Sharples Corp.

Classifiers.....Covers physical characteristics, automatic control mechanism, theory, method of operation, applications, and advantages of new hindered settling hydraulic classifiers. Illustrated Bulletin 2342.
479C Dorr Co.

Classifiers, Continuous Centrifugal..... Company makes available descriptive literature on continuous centrifugal classifiers—what they do, how they work, with examples and pictures of successful applications.
479D Bird Mach. Co.

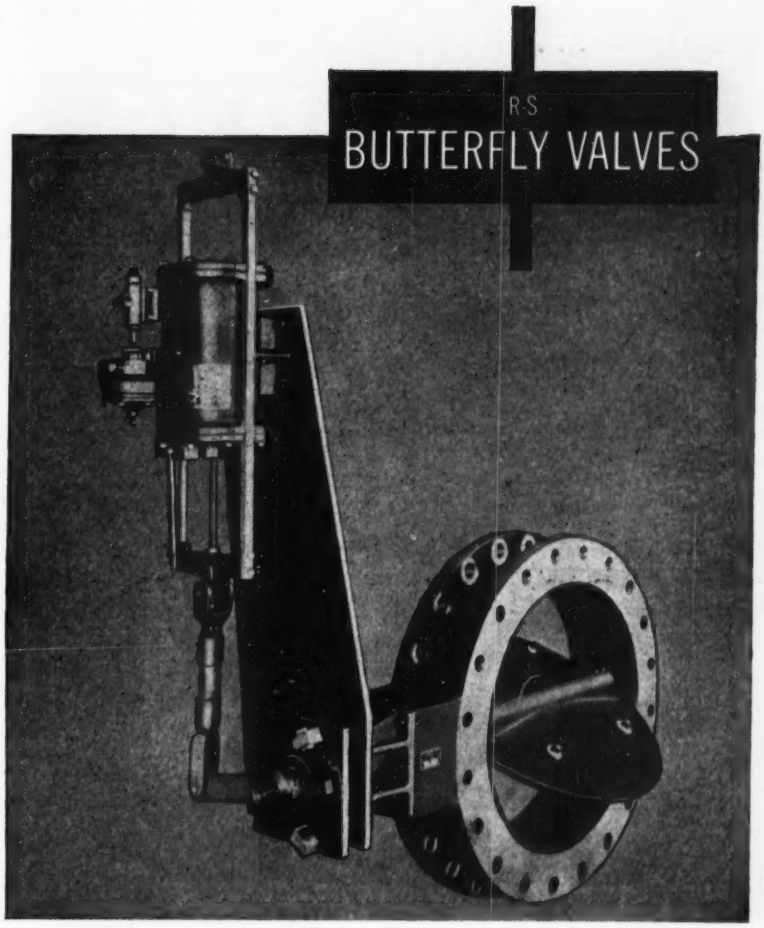
Converters, Dry Ice.....Dry ice converters are A.S.M.E. code pressure vessels especially adapted to charging with full 50-pound cakes of solid CO_2. Feature no operating costs. Folder offers complete details.
R416 Dry Ice Converter Corp.

Demineralizers.....Water demineralizers are backed by more than 75 years of water purification experience & are made in sizes & models for every pure water need. Describes complete line in detailed Catalog 127.
285 Barnstead Still & Sterilizer.

Discs, Rupture, Safety Head.....Developed for low pressure applications of a type, which, because of extreme corrosive conditions, cannot be handled by the standard pre-bulged type of disc. Complete details.
359 Black, Sivalls & Bryson.

Dryers.....Lectrodyers can dry air and gases in volume to dewpoints below —100°F—can drop relative humidity lower than 10%. Booklet describes machines and how various industries use them to gain efficiency.
99 Pittsburgh Lectrodryer Corp.

Dryers, Rotary.....Vulcan rotary dryers designed & constructed to give maximum performance with a minimum of maintenance. Describes rotary kilns, coolers, dryers, retorts, etc., in illustrated Bulletin A-442.
68 Vulcan Iron Wks.



R-S VALVES FOR SENSITIVE CONTROL

These design features have won complete process control acceptance for R-S Butterfly Valves. In your processing system, an R-S Valve will give you every advantage in . . .

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...fast regulation and control
...minimal pressure drop
...compactness and lightweight at less cost.

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Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

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Dryers, Rotary, Direct Fired.....If your products are not critical to high temperatures they can be dried more economically in a Davenport flash or direct fired dryer. A complete Catalog furnishes details.
TL445 Davenport Mach. & Foundry.

Drying, Vacuum.....Provides an informative brochure, "Vacuum Drying," which contains descriptions of the techniques of moisture removal from chemicals, pharmaceuticals, and other industrial products.
275 F. J. Stokes Mach. Co.

Dust Collectors.....In almost every type of industry...users have found the high efficiency, simplicity, and economy of Dustube collectors a difficult combination to equal for top performance. Catalog No. 372.
89 American Wheelabrator.

Dust Collectors.....Reverse-jet dust collector provides many features: cleans as it filters—without interruption to operations; maintains filter porosity; prolongs filter life; etc. Offers descriptive 12 p. Booklet.
317 Western Precipitation Corp.

Dust Control.....Describes dust control and its advantages. Outstanding reclamation savings result from effective trapping of valuable chemical dusts. Maintenance costs lowered. Details in Bulletin No. 909-A.
493 Pangborn Corp.

Dust Control.....Describes most direct method for determining the scope of your dust problem & your dust control equipment needs in new manual, "A Simplified Test Method for Dust Control Determination."
R443 Dustex Corp.

Dust Filters.....Feature constant suction at dust sources, self cleaning for continuous operation, no auxiliary motors or blowers, no abrasion of bags by cleaner, less overall height & floor space. Bulletin 102.
481 W. W. Sly Mfg. Co.

Eliminators, Mist.....Effectively and economically control liquid entrainment resulting from processing operations which involve handling of liquids and gases together. Catalog provides full information.
357 Metal Textile Corp.

Filters.....Describes permanent membrane type liquid filters. Covers precoating, filtering & cleaning operations, with schematic drawings showing flow directions during each of the phases. Illustrated Folder F 10-54.
480A Wagner Bros

Filters, Disc.....Size: 2', 4' and 6' dia. 2 to 8 disc. Features: oversize center shaft, simple renewable automatic valve. Furnishes a descriptive Technical Bulletin containing complete and detailed information.
M443b Denver Equipment Co.

Filters, Pressure Leaf.....Supplies valuable literature outlining the design and construction advantages of new pressure filter. Also provides a table of filter sizes and capacities covering sixty-six models.
480B Bird Mach. Co.

Filters, Rotary Vacuum.....Covers unique design features . . . for handling both slow filtering & free filtering solids; how it discharges thin cake by pneumatic blow-back, & utilizes thorough counter-current wash.
480C Bird Mach. Co.

➔ Want more information on any of these items? Just circle its code number on the postcard inside the back cover, then mail to us. It's that easy now.

Generators, Inert Gas.....Aid in solution of purging or blanketing problems. Complete with the latest fire checks and safety devices. For essential details and technical information request Bulletin 1-10.
83 C. M. Kemp Mfg. Co.

Grinding & Blending Systems.....Integrated system features savings in time and money in combined functions of grinding, blending and dust control. Results in greatly increased production. Illustrated Bulletin.
429 Pulverizing Machy. Div.

Kettles..... Corrosion-resistant kettles meet every processing need. They are practical, easy to clean and keep clean, meet all sanitary regulations and are available in sizes up to 500 gal. capacity. Offers Bulletins.
TR420 Lee Metal Products Co.

Kettles, Processing..... Buflovak-Dopp kettles with scraping agitator speed production . . . make a better product . . . save money. Valuable information concerning processing kettles in illustrated Catalog 356-R.
58 Buflovak Equipment Div.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features in illustrated Bulletin No. 115.
309a Traylor Engrg. & Mfg. Co.

Mills.....For grinding, mixing, emulsifying, homogenizing, disintegrating & dispersing all types of products including paints, inks, chemicals, ceramics, plastics, etc. Data in 16 p. fully illustrated Bulletin.
480D Morehouse Industries.

Mixers.....Homo-Mixer is built & operates on an entirely new principle. Draws only from the bottom of the tank with no vortex. Contains complete information on features & operation in Catalog No. 402.
TR451 Admiral Tool & Die Co.

Mixers.....Mixers meet tremendous variety of fluid mixing needs. Includes valuable information on the company line of side entering mixers, top entering mixers, turbine mixers, etc., in Fluid Mixing Catalogs.
495 Eastern Industries.

Mixers.....Agitation specialists show how their services can help you attain the desired goal in process agitation—highest efficiency at lowest outlay cost. Covers mixer line in illustrated Catalog B-105.
209a Mixing Equipment Co.

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
209b Mixing Equipment Co.

Mixers.....Meet requirements for heavy-duty kneading & mixing. Feature air seal type stuffing boxes, new dumping mechanism, heavy-duty bearings, etc. Find complete information in illustrated Bulletin No. 600.
63 J. H. Day Co.

Mixers, Laboratory.....Laboratory mixers: electric motor driven, direct drive, variable speed and geared models. Air motor driven models also available. Provides complete details in Bulletin DH-50.
209c Mixing Equipment Co.

Mixers, Portable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.
209e Mixing Equipment Co.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.
209f Mixing Equipment Co.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure and vacuum . . . for open and loose-covered tanks. Data in Catalog B-103.
209g Mixing Equipment Co.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. No. B-102.
209h Mixing Equipment Co.

Process Equipment.....Illustrates & describes with use & application data & specifications line of pressure filters, ion exchangers, centrifugal pumps, heat exchangers & rubber lining service. Catalog CEC-55.
480E Industrial Filter & Pump.

Propellers.....Data on smooth, vibrationless propellers for stirring, mixing, aerating, pumping, etc. Balanced to avoid whip and strain on shafts. Available in wide variety of metals, and in sizes to 60 inches.
BL445 Michigan Wheel Co.

Scrubbers, Gas.....Installations of this equipment successfully handle difficult gas scrubbing problems. Help stop air pollution and recover valuable materials. World-wide usage. Information in Bulletin M-102.
86 Chemical Construction Corp.

Settling & Filter Systems.....Provides information on the Delpark settling and filter system . . . for continuous removal of chips, heavy solids and relatively fine solids to .004" screening. Fully illustrated.
480F Industrial Filtration Co.

Strainers, Self-Cleaning.....For protection of process equipment, turbines, regulators, valves. Covers data on uses, strainer screens, specifications, dimensions, ordering, etc. in illustrated Bulletin No. 5308.
480G Leslie Co.

Thickeners, Spiral Rake.....Simple mechanical rake and settling unit for the separation of solids from liquid is subject of a new, detailed Bulletin. Valuable features, drawings, photographs, etc. No. T5-B5.
M443a Denver Equipment Co.

Vacuum Systems, Industrial.....Powerful suction of the Hoffman system is the perfect supplement to regular ventilating-collecting installations for 100% effective control of dust & dry material. Detailed Booklet.
235 U. S. Hoffman Machy. Corp.

Pumps, Blowers, Compressors

Blowers.....Precision manufactured to move more gas or air with less wear than other blowers of equal size or weight . . . and with less maintenance and power costs. Describes blowers in detailed Bulletin B-154.
372 Read Standard Corp.

Compressors, Rotary.....Operate with minimum maintenance cost. Built in single & two-stage units for capacities to 3300 cfm, pressures to 125 lbs. Full description of these modern machines in Bulletin No. C-5A.
84 Fuller Co.

Exhausters.....Cost records in hundreds of plants reveal that the company line of rubber-lined exhausters last from three to twelve times longer than ordinary metal fans. Complete details in Bulletin No. 2424-F.
395 Buffalo Forge Co.

Fans.....Backward curve unit designed to give quiet, high efficient, stable operation through a wide performance range with the protection of absolute non-overloading characteristics. Data in 44 p. Bulletin No. 2500.
480H Robinson Ventilating Co.

Fans.....Company furnishes new literature containing detailed specifications, performance charts, dimension tables, etc. regarding their line of "MD" fans. Complete information in Bulletin MD-101.
481A Chicago Blower Corp.

Pumps.....Worthite product line offers solution for pumping problems which involve corrosive fluids. For complete information on these rugged units, company makes available upon request Bulletin W-350-B16.
97 Worthington Corp.

Pumps, Centrifugal.....A vertical split case pump with balanced loading of impeller & bearings . . . capable of handling loads far in excess of those produced by any pump & motor combination. Complete data.
48 Bell & Gossett Co.

Pumps, Centrifugal.....Help solve problems which involve pumping a liquefied gas at extreme low temperature. Company offers descriptive Bulletin containing summary of acid & chemical pump data. No. 203-6.
375 Lawrence Pumps.

Pumps, Centrifugal.....Furnishes Bulletin describing the new end suction centrifugal pump. Includes materials of construction, features of design, performance tables, dimensions, etc. Illustrated, 12 p. No. 4011.
481B Deming Co.

Pumps, Centrifugal.....Seal-less, leakproof pumps—the answer to all maintenance & operating troubles inherent in mechanical seals & stuffing boxes of conventional centrifugal pumps. Data in Bulletin G-1000.
73 Chempump Corp.

Pumps, Centrifugal Vertical.....Designed to handle molten sulphur. Steam jacketed discharge pipe keeps molten materials from solidifying. Efficient at relatively slow speed of 1750 rpm. Bulletin V-837.
BL389 Taber Pump Co.

Pumps, Chemical.....Data on corrosion-resisting pumps for heavy-duty chemical service. Available in 12 standard alloys to supply heads to 240 ft. & capacities to 2000 gpm. Find information in Catalog No. 54.
241 Duriron Co.

Pumps, Controlled Volume.....Literature includes: Application Engineering. Data Sheet No. A-54-2, "Instrumentation of a Continuous Reactor" & Bulletin No. 1053, "Air-Powered Controlled Volume Pumps."
313 Milton Roy Co.

Pumps, Diaphragm.....Size: 1 "Simplex to 6" Quadruplex. Features: adjustable stroke, molded rubber valve seats, positive action. Find valuable information on these pumps in fully detailed Technical Bulletin.
M443c Denver Equipment Co.

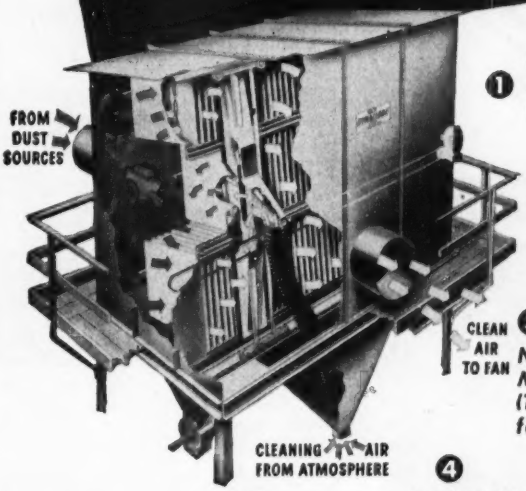
Pumps, Double Suction.....Major advantages include: top performance; easy maintenance; lastingly high efficiency; long-life. For complete information on the Buffalo line of pumps request Bulletin No. 982.
14 Buffalo Pumps.

Pumps, Gear.....Maintain high efficiency handling corrosive liquids. 32 ssu to 1,000,000 ssu; 1-550 gpm; 250 psi for viscous liquids, 50 psi for water. Direct-connected up to 1800 rpm. Details in Bulletin G-2.
TR422 Sier-Bath Gear & Pump Co.

Pumps, Liquid.....Pump viscous fluids efficiently and economically . . . and serve as combined meter and pump due to their unusually high volumetric efficiency. Describes the entire line in Bulletin No. L51.
R391 Kinney Mfg. Div.

Pumps, Process.....Pumps available with or without Equiseal stuffing box, in wide choice of materials to handle many types of abrasive or corrosive material at temperatures to 250°F. Illustrated Bulletin 52B6615.
337 Allis-Chalmers Mfg. Co.

THE
DYNACLONE
PATENTED
The ULTIMATE in Dust Filters



1. CONSTANT SUCTION at dust sources.
2. SELF CLEANING for continuous operation.
3. NO AUXILIARY MOTORS or BLOWERS (The main operating fan does the cleaning).
4. NO ABRASION of BAGS by the CLEANER.
5. LESS OVERALL HEIGHT and FLOOR SPACE.

HOW IT OPERATES

(a) Dust laden air is drawn in from the dust sources as indicated by the shaded arrows.
(b) It is diffused into the dust chamber by the baffle plate.
(c) It is then drawn through the fabric of the filter bags and is cleaned as shown by the clear arrows.
(d) Clean air passes out of the case and goes to the suction fan.
(e) Concurrently, the traveler moves back and forth across the dust wall registering successively with one bag at a time.
(f) The suction which exists in the dust chamber draws a blast of atmosphereic air through the bag in reverse directions and cleans that bag. (No shaking.)

Control your industrial dust better, for less — with the Sly Dynaclone. May we explain how?

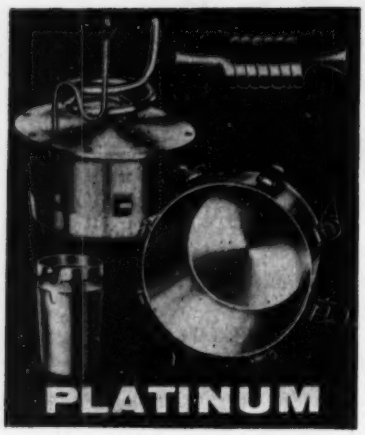
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LITERATURE . . .

Pumps, Process.....De Laval CPO process pumps handle numerous liquids: salt brine; sea water; caustic solution; soap solution; etc. Capacities to 2000 gpm—heads to 200 ft. Details in Bulletin 1125-B.
297 De Laval Steam Turbine Co.

Pumps, Proportioning.....3 pumps in one—7,500, 15,000 or 30,000 psi working pressure made possible by interchange of piston and cylinder assemblies in the same pump frame. Information in Bulletin 4061-A.
BR385 American Instrument Co.

Pumps, Rotary.....Feature fast, thorough stripping action. Efficient stripping is possible because of suction lift created by the "gear-within-a-gear" pumping principle. Complete details in Folder No. 54SC.
BR426 Viking Pump Co.

Pumps, Rotary Piston.....A self-priming pump that works by displacement system operating with the qualities of a centrifugal pump. Describes type, method of operation and dates, in 6 p., illustrated Bulletin.
482A Neumann & Welchman.

Pumps, Vertical.....New designs provide both a process type and a transfer type...for application to chemical processing, refining techniques, condensate service and line booster service. Bulletin B-1700.
47 Peerless Pump Div.

Instruments & Controls

Analyzers, Gas.....Valuable information on gas analyzers for thermal conductivity measurements. Describes features, principle of operation, physical specifications, special applications, etc. Illustrated.
482B Charles Engelhard.

Analyzers & Recorders.....The paramagnetic method of measurement is extremely accurate in analyzing industrial gases. Complete information on Magno-Therm O_2 Analyzer & Recorder in Bulletin No. 52-829-56.
419 Hays Corp.

Control Pilots.....Pertinent information on liquid level, pressure & temperature pilots. Includes data on unique design, features, operation, applications, selecting, specifying & ordering, etc. Bulletin No. 5303.
482C Leslie Co.

Controls, Thermal.....Help solve temperature control problems which involve heat, humidity, radiant heat, pressure and other variables. Detailed description of Thermoswitch units in illustrated Catalog No. 400.
92 Fenwal, Inc.

Controls, Valve.....LimiTorque is the latest and most advanced valve control for operation of small valves. Includes description, application, features, ordering information, etc. Illustrated Catalog L-54.
40 Phila. Gear Wks.

Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean & smooth. Provides complete information in Gage Catalog No. G-2.
361 Helicoid Gage Div.

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BL391 Strahman Valves.

Gages, Tank.....Company makes available pertinent information on their line of 100% automatic Liquidometer tank gages for gaging liquids of all kinds. Gages are approved by the Underwriters' Laboratories.
BL416 Liquidometer Corp.

Governors, Zero Gas.....Deliver gas in varying quantities but at consistent "zero" pressure without being affected by variations at governor inlet. Are available in six sizes. Contains full data in Bulletin M-400.
483A Eclipse Fuel Engrg. Co.

Indicators, Temperature.....Offer many important features: large capacity; easy-to-read; speedy; twenty-three scale ranges; accurate; sensitive; durable; etc. For complete information request Bulletin 61-E.
366 Thermo Elec. Co.

Measuring Systems, Temperature..... Foxboro Dynalog-Dynatherm combination insures better temperature measurement on any job between —100° and +600°F. Illustrated Bulletins describe numerous advantages.
80a Foxboro Co.

Measuring Systems, Torque.....Company furnishes new descriptive Booklets with information on how you can benefit by using SR-4 Device systems to measure electronically either load, torque or fluid pressure.
85 Baldwin-Lima-Hamilton Corp.

Meters.....Accurate and dependable . . . will safely handle over 856 different liquids in processing, blending, packaging and numerous other batching or blending operations. Presents descriptive information.
T496 Bowser, Inc.

Meters.....Describes Conveyoflo meters —for continuous, accurate weighing of bulk materials passing over conveyor belts. Respond accurately to rapid load variations. Covers data on features in Bulletin 550-H4.
325 Builders-Providence.

Meters, Flow.....Feature simple design with only three moving parts—no breakdown due to complicated gears and mechanism. Indicate flow within 3% absolute accuracy, even with pulsating flow. Detailed Bulletin.
BR422 Henszey Co.

Meters, Flow.....Includes major design & construction features, maximum flow ranges & various combinations of metering tubes & bypass valves which can be used in series. Details in illustrated Bulletin No. 1053.
483B Commercial Research Labs.

Meters, Flow.....In performance, flow meters provide unsurpassed precision . . . reliability . . . convenience . . . with minimum maintenance requirements. Offers complete details in new Catalog No. 2320.
245 Minneapolis-Honeywell.

Meters, pH.....Provide new dependability, new convenient size, new maintenance ease (thru plug-in units), and new facility for process automatization. For complete details on Model W request Data File 89-17.
483C Beckman Instruments.

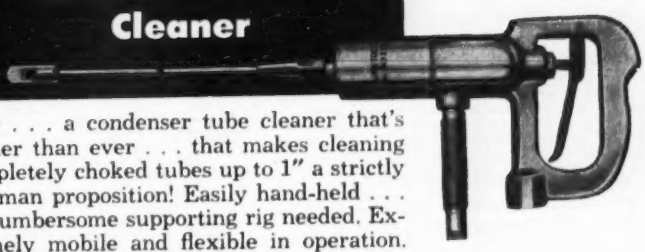
Ozonators, Laboratory.....Are designed as precision laboratory instruments capable of constant and reproducible operation, positively safe to use. Find complete details on the Model T-23 in descriptive Folder.
6-7a Welsbach Corp.

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Potentiometers.....Offers valuable information on high precision, single turn, continuous-rotation potentiometers... three inches in diameter...for servo or bushing mounting. Illustrated Data Sheet No. 305.
484A Helipot Corp.

Pyrometer Accessories.....A new Bulletin entitled, "Alnor Pyrometer Accessories," is made available to all those concerned with the installation, use and maintenance of pyrometer systems. Illustrated. No. 4181.
484B Illinois Testing Labs.

Pyrometers, Portable.....Line of sturdy precision instruments bring instant, accurate results . . . wherever temperature readings are required—on the production line, in the lab, or in the field. Detailed Bulletin.
M428 Illinois Testing Labs.

Stresometers.....Offers detailed reference, "A New Instrument for Measuring Stress in Electrodeposited Metals." Covers description, theory sensitivity and accuracy, reproducibility, advantages, etc.
484C Joseph B. Kushner.

Temperature-Monitoring Systems..... Can handle wide variety of temperature-monitoring problems when compponents are used as "building blocks." Includes applications, operation data, specifications, etc. Bulletin 70.
484D Thermo Elec. Co.

Thermometers.....Sturdy all-metal construction resists breakage, makes for far longer life on operating equipment. Exclusive multiple helix assures dependable accuracy during long life. Detailed Bulletin.
312 Weston Elecl. Instrument.

Transmitters, Pneumatic.....36 p. reference covers transmitters for measuring flow, pressure, level or density. Offer longer life, less maintenance, continuous, accurate operation. Information in Data Book 1004.
299 Republic Flow Meters Co.

Transmitters, Pressure, Differential..... Pneumatic force-balance transmitters designed to convert differential pressure into an equivalent 3 to 15 psi output. Details on versatile instrument in Bulletin 98097.
140-1 Taylor Instrument Cos.

Viscometers.....For recording or recording-controlling of viscosity in industrial plants. Illustrated Bulletin explains what they are, how they work and cites numerous advantages for precision instruments. No. 16.
484E Norcross Corp.

Weighing & Calibrating Systems..... Company makes available an illustrated Bulletin describing their new weighing and calibrating system. Includes data on operation, application, specifications and performance.
484F Morehouse Mach. Co.

Wire, Thermocouple & Extension..... Issues a new Bulletin describing & illustrating complete company line of thermocouple wire & thermocouple extension wire. Covers various sizes, metals, insulations, etc.
484G Claud S. Gordon Co.

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484H Metalweld, Inc.

Coatings, Protective.....Low cost, long lasting protection for all types of steel or concrete structures. Technical Bulletin provides a complete description of the coating's chemical and physical properties.
215 Amercoat Corp.

Coatings, Protective.....Offer valuable features: chemical-weather-abrasion —resistant; elastic; tough & durable; etc. Covers instructions for use, specifications & specific resistance. Data Sheet No. CP-575.
484I Pennsylvania Salt Mfg. Co.

Copper.....By using copper and its alloys, brass and bronze, your product is easier to fabricate, better and more durable. Literature includes a new, valuable booklet, "Copper . . . Today and Tomorrow."
16-7 Copper & Brass Research

Fabrication, Metal.....Booklet, "Facilities & Products," with information & photographs which show why company can turn out—at low cost—specialized heavy equipment for chemical plants, now made available.
77 Newport News Shipbuilding.

Fabrication, Metal.....Complete fabricating and assembling facilities for any type, size and quantity of sheet and plate products and weldments thru ⅝" thickness. Offers details in "Sheet and Plate Fabrication."
486 Kirk & Blum Mfg. Co.

Flooring, Safety.....Describes product developed to meet the requirements of hard surface safety flooring in the industrial and ordnance fields. Covers numerous advantages and features in Technical Bulletin 28.
484J Master Builders Co.

Insulation.....Describes Mono-Block—the one-block insulation for temperatures up to 1700°F. Bulletin includes information on composition, properties, efficiency, and low applied cost. Illustrated.
358 Baldwin-Hill Co.

Insulation, Pipe.....Snap-On pipe insulation now available in a complete range of sizes and thicknesses for piping from ¾" to 24" in diameter. Offers a new Brochure with full descriptive and technical data.
50 Gustin-Bacon Mfg. Co.

Lead Products.....For the efficient control of corrosives. Provides all common mill shapes, sizes & forms . . . sheet, pipe, fittings, valves, etc. Makes available new detailed booklet, "Chemical Lead Products."
139 National Lead Co.

Linings, Protective.....Liquid neoprene base protective linings feature excellent chemical resistance and mechanical properties. Covers application instructions and specifications in Data Sheet No. CP-578.
484K Pennsylvania Salt Mfg. Co.

Metal Specialties.....Complete service on metal specialties. Crates, trays, racks, baskets, etc.—designed and built for specific materials handling, heat-treat and corrosion resistant end use. Detailed Catalog.
R393 Cambridge Wire Cloth Co.

Mortars, Corrosion-Resistant.....Bulletin provides valuable data on line of Delrac furane cement & polyester cement. Covers chemical resistance, physical properties, instructions for use, etc. 4 p. No. 500.
484L Delrac Corp.

Mortars, Corrosion-Resistant.....Chemical-resistant cement mortars...for bonding and pointing corrosion-proof masonry construction. Covers applications, selection, ordering, etc. in Data Sheet No. CP-602.
484M Pennsylvania Salt Mfg. Corp.

Process Equipment, Fabrication..... Complete modern facilities including X-ray inspection & stress relieving which insure quality control. Equipment in all commercial metals & alloys. Catalogs 501 & 550.
322 L. O. Koven & Bro.

Process Equipment, Fabrication.....Designed and built around the use of Haveg—basic construction material that resists corrosion. Includes size and chemical resistance charts in 64 p. illustrated Bulletin F-6.
331 Haveg Corp.

Steels, Stainless.....Descriptive 36 p. booklet, "Heat Treating, Forging & Pickling of Armco Stainless Steels," provides complete heat treating information, with valuable reference charts & photomicrographs.
484N Armco Steel Corp.

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424 Crucible Steel Co.

Steels, Stainless.....Presents 32 p. manual, "Surface Finishing of Armco Stainless Steels." In addition to abrasive polishing there is information on Armco Electropolishing Process, blackening & etching.
484O Armco Steel Corp.

Tantalum Equipment.....Immunity to hydrochloric, nitric & perchloric acids, iodine, bromine, etc., eliminates shutdowns, repairs, lost production time, spoilage, fume damage & other costly corrosion results.
348 Fansteel Metallurgical Corp.

Titanium.....Shows resistance to chloride solutions and retains useful strength up to 800-1000F. Other advantages and data on application and fabrication of titanium alloys in descriptive Rem-Cru Review.
438 Rem-Cru Titanium.

Pipe, Fittings, Valves

Elbows, Long Tangent.....Feature many advantages: save pipe; often eliminate short nipples and their extra welds; save time and money in lining up and clamping pipe and fitting; etc. Data in Catalog No. 54.
433 Midwest Piping Co.

Fittings.....Offers Klinger Master Catalog describing the complete range of products.....compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers.
239a Klinger Corp. of America.

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91 Atlantic Metal Hose Co.

Hose, Metal, Flexible.....Manufacturer provides a complete description of varied applications for flexible metal hose & tubing. Shows how tubing is designed, used & installed. Data contained in Catalog CC-400.
65 American Brass Co.

Joints, Expansion, Piston-Ring.....In a full range of sizes, with 4", 8" or 12" traverse per slip, for pressures to 400 psi & greater & for temperatures to 800F & higher. Advantages covered in Bulletin 35-15H.
269 American District Steam Co.

Joints, Swivel.....A new, 32 p. Catalog covers the complete company line of ball-bearing swivel joints & other products, including loading racks, manifolding lines, all-metal marine & barge hose, etc. No. G-4.
485A Chiksan Co.

Nozzles, Spray.....Company makes available on request a completely detailed Catalog which provides valuable data on Spraco Nozzle line. Includes information on full cone, flat spray & hollow cone types.
TL391 Spray Engrg. Co.

Pipe, Clay.....Illustrated Bulletin covers special uses of Screw-Seal clay pipe for industrial installations. Provides valuable features: leak, rust & corrosion-proof; flexible; fast, easy installation; etc.
485B Robinson Clay Product Co.

Pipe & Fittings, Glass.....Glass pipe & fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Details in Catalogs EA-1 & EA-3.
153a Corning Glass Wks.

Pipe, Fittings & Valves.....For those operations which require the conveying of corrosive liquids. Feature valuable advantages of easy installation, added safety, no leakage, etc. Catalog details company line.
356 Saran Lined Pipe Co.

Tubing, Metal, Flexible.....Scientific application of flexible tubing for air, oil, steam, gases & volatiles. Makes available valuable engineering information on all tubing & couplings in illustrated Folder.
302 Penna. Flexible Metallic.

Tubing & Pipe, Stainless.....Furnishes solution for corrosion problems . . . handling of strong acids and other severe corrodents. New Bulletin offers complete details on Carpenter Stainless No. 20 products.
441 Carpenter Steel Co.

Tubing Steels.....Technical Data Card presents stress rupture data on 11 tubing steels used in high temperature service. Includes carbon steel, intermediate chrome-molybdenum steels & stainless steels. No. 153-A.
485C Babcock & Wilcox Co.

Valves.....Efficient, dependable valves can lower your processing costs—by controlling flow precisely . . . by providing extra-long wear to reduce costly maintenance. Presents Catalog information upon request.
75 Ohio Injector Co.

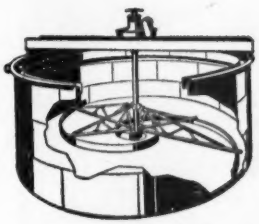
Valves.....Steel dry plug valves that need no lubricant & cast steel gate valves both meet the exacting needs of the petroleum, petro-chemical, & chemical industries. Data in Stockham & Wedgeplug Catalogs.
410 Wedgeplug Valve Co.

Valves.....A "Technical Tips" booklet describing & illustrating data gathered by the Edward laboratories on valve material, installation, & usage has just been published & is now available. Bulletin 542.
485D Edward Valves.

Valves, Check.....Low head loss, increased wear resistance and freedom from destructive slamming make line of tilting disc check valves unbeatable for almost every installation. Details in Catalog No. 30.
286 Chapman Valve Mfg. Co.

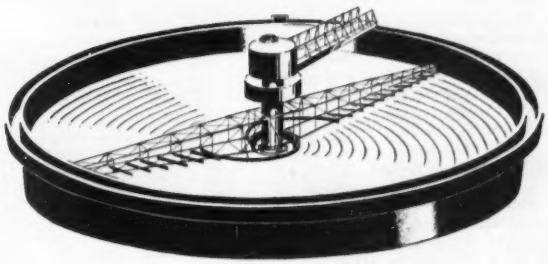
Valves, Control, Temperature.....Give you super-sensitive control of air flow for accurate, low cost proportioning or "off-on" control. Adjustable to wide range of open and shut speeds. Full details in Bulletin M-200.
485E Eclipse Fuel Engrg. Co.

Valves, Diaphragm Control.....Double seated diaphragm control valves offer quality features: ISA Standard face-to-face dimensions; "flow-line" contoured body; self-aligning guides; etc. Data in Bulletin 5305.
485F Leslie Co.



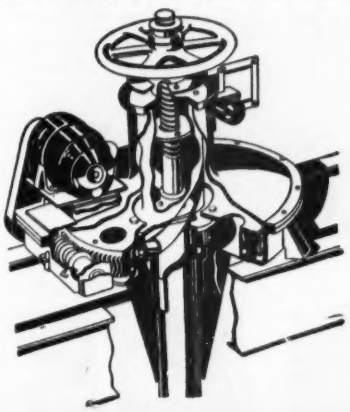
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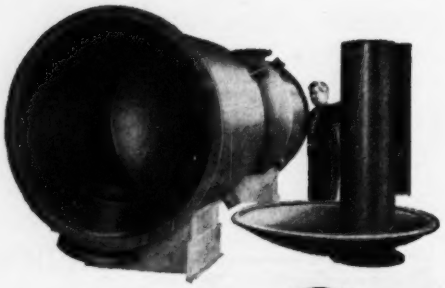
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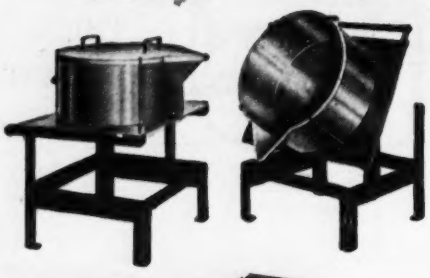
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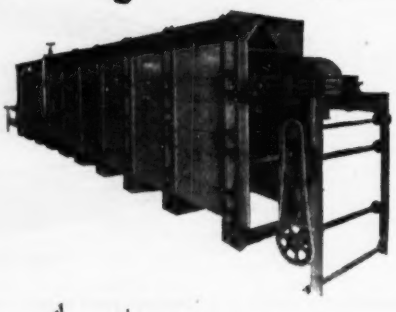
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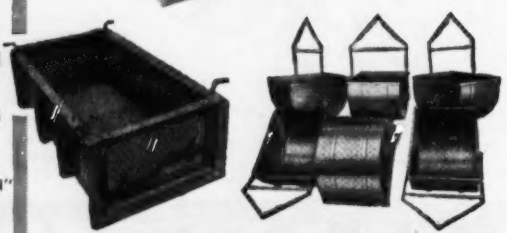
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Valves, Gas.....Motorized gas valves combine high capacity and soft seat positive shut-off in sturdy light weight aluminum bodies. For use with all commercial fuel gases. Provides full data on line. Bulletin M-600.
468A Eclipse Fuel Engrg. Co.

Valves, Gate.....Hard rubber lined iron body gate valves for big savings in many corrosive services. Feature fully revolving double dics, parallel seat principle. Supplies complete information in detailed Bulletin.
154 Darling Valve & Mfg. Co.

Valves, Multi-Port.....Provides valuable information on rubber seated multi-port valves . . . for water softeners, pressure filters and ion exchangers. Available in ¾ to 4-inch sizes. Request detailed Catalogs.
377 AquaMatic, Inc.

Valves, Packless.....For use wherever pipelines carrying gasoline, oil or other volatile liquids & vapors must have positive protection against leakage. For complete information request Bulletin No. TC-813.
364 Fulton Sylphon Div.

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics, and specifications.
87 Lapp Insulator Co.

Valves, Pressure Reducing.....Presents a completely illustrated Bulletin covering the company line of pressure reducing valves. Includes engineering, operating and maintenance data in 20 p. reference. No. 461-B.
486B Leslie Co.

Valves, Pump.....Pump valves will operate freely under extremes of high or low temperature, with highly corrosive fluids, and in any position. Company Bulletin presents essential and detailed information.
470 Durable Mfg. Co.

Valves, Safety Shut-Off.....Operate instantly...must be reset manually... protect you fully against gas, air, or electrical failures. Choice of 5 power units for variety of control combinations. Bulletin M-302.
486C Eclipse Fuel Engrg. Co.

Valves, Solenoid.....Presents numerous valves—two-way, three-way, four-way—for automatically controlling the flow of liquids & gases. Valve Catalog gives complete information on extensive line. No. 24.
411 Automatic Switch Co.

Electrical & Mechanical

Chains, Roller.....For power transmission or conveying. Positive, flexible, economical chain with high sustained efficiency. Lock-type bushings for long roller chain life. Offers 148 p. illustrated Data Book 2457.
407 Link-Belt Co.

Cleaners & Expanders, Tube.....Tube cleaners and tube expanders keep tubes at peak efficiency, reduce down time due to tube failures. Quickly remove hardest deposits from straight or curved tubes. Complete data.
482 Airetool Mfg. Co.

Drives, Adjustable-Speed.....Describes features and advantages of all-electric adjustable-speed drives which provide automatic load control for safe, high-speed pulp grinding, in illustrated Bulletin D-2311.
54 Reliance Elec. & Engrg. Co.

Drives, Electric Power.....Company line of electric power drives engineered to your requirements. Covers Speed-Trol, Slo-Speed, Klosd and Klosd-Tite electric power drives. 20 p. illustrated Catalog No. 574.
64 Sterling Elec. Motors.

Drives, Shaft Mounted.....These versatile, new speed-reducing units save space, power, material and time. Makes available an Engineering Bulletin which includes selection and dimension details.
103 Falk Corp.

Electric Equipment.....28 p. offers data on: G-E electrical equipment for power generation; power distribution & conversion; power utilization; instrumentation; descriptive publications; etc. Bulletin GED-1966A.
487A General Elec. Co.

Fasteners, Stainless Steel.....Stainless fasteners & pipe fittings in stock. All types & sizes of screws (hex head, Phillips, slotted, socket), bolts, nuts, rivets, etc. Offers complete details in Manual No. P6.
TL387 Allmetal Screw Products Co.

Gaskets, Teflon.....The ideal seal for many process applications is a Flexitallic gasket with teflon trapped between edges of stainless steel. For complete data request folder, "Teflon in Flexitallic Gaskets."
342 Flexitallic Gasket Co.

Gaskets, Teflon-Jacketed..... Includes pertinent information on corrosion-resistant teflon-jacketed gaskets for glass-lined steel connections, Corning conical flanges, etc., in illustrated Catalog No. TG-953.
354 U. S. Gasket Co.

Motor-Starter-Circuit Breakers.....Explosion-proof, dust & rain—tight circuit breaker & motor starter Unilets offer superior design, construction & performance. Valuable technical data in Bulletin BH.
228-9 Appleton Elec. Co.

Motors.....Features pre-lubricated motor bearing that has four seals..... Two on each side. Offers real bearing protection—grease is sealed in & contaminants are sealed out. Covers details in Booklet B-6154-A.
30-1 Westinghouse Elec. Corp.

Motors.....Meet the toughest conditions. Ribbed frame provides effective heat radiation . . . fan-driven cowl-directed air-blast carries off heat, & also prevents settling of dust on motor frame. Request Bulletin.
327 Elliott Co.

Motors.....The extra dependability of Electro Dynamic motors covered in new report, "Motor Showdown." Includes data on comparative results of motor performance tests. Also a Catalog of industrial motors.
376 General Dynamics Corp.

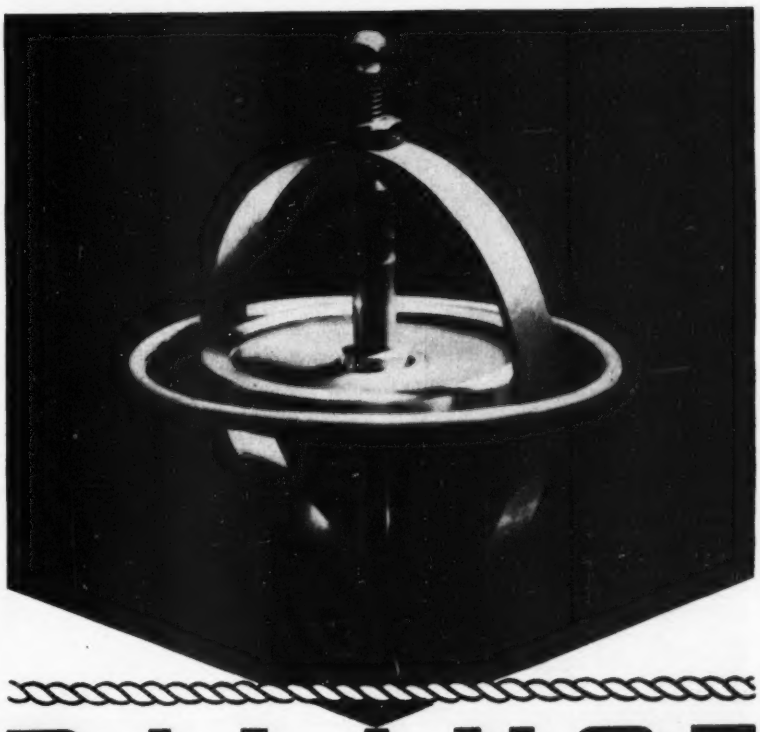
Motors, Fan-Cooled.....Cartridge bearing design lowers maintenance: bearings protected at all times . . . can be relubricated . . . run longer between grease periods Details in Bulletins MU-132 & MU-196.
281 Wagner Elec. Corp.

Motors, Fan-Cooled..... Totally-enclosed, fan-cooled motors . . . for chemical plant applications. Feature long life, minimized maintenance and top efficiency. Details in Chemical Motor Bulletin No. CE-3379.
417 Diehl Mfg. Co.

Motors, Pump.....Provides complete data and illustrative diagrams on the major dimensions of these motors which are especially suitable for deep well irrigation installations and industrial pumping applications.
487B Belgian Elec. Sales Corp.

Packings, Teflon.....Cut packing replacement and maintenance costs. Stop leakage by providing tight seal at only slight gland pressure. Last for many months under corrosive conditions. Detailed Catalog.
360 Chemical & Power Products.

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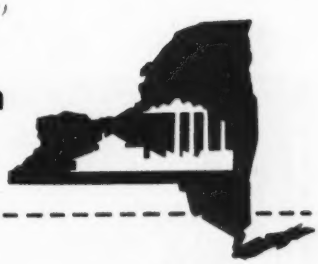
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plant-location news



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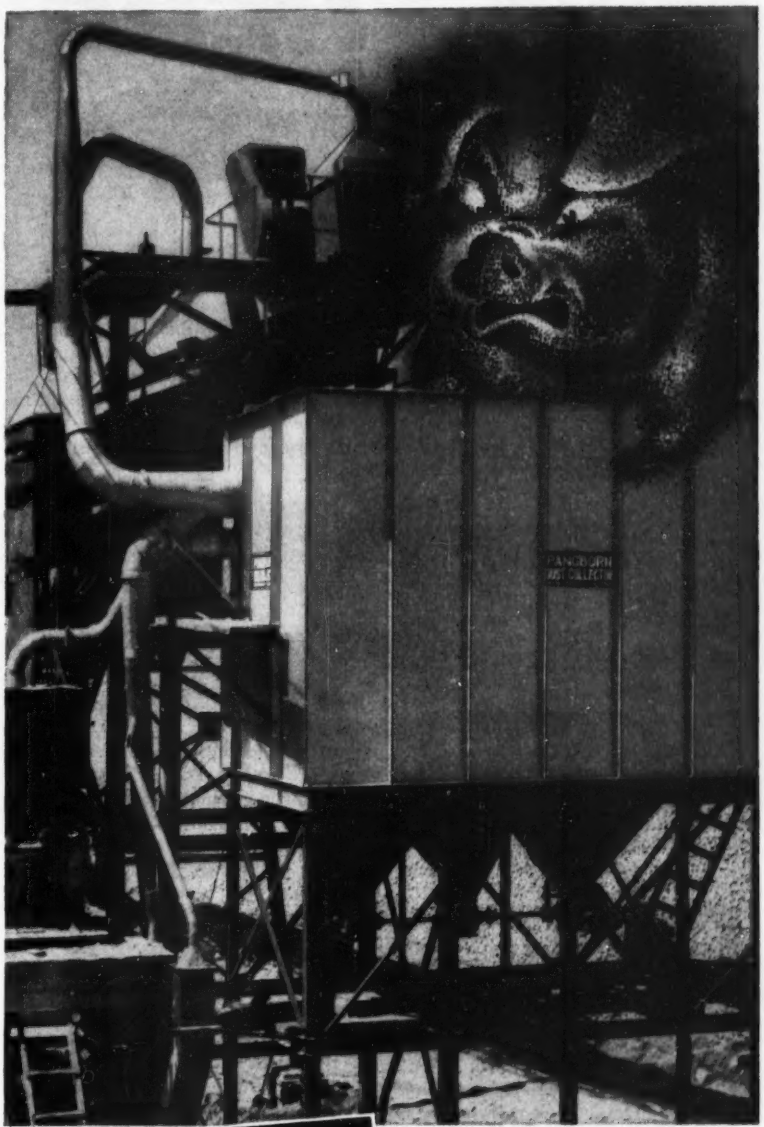
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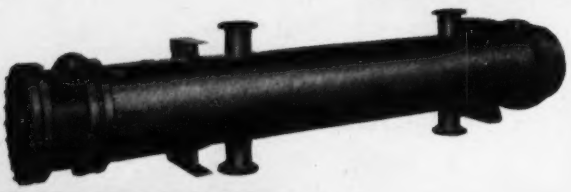


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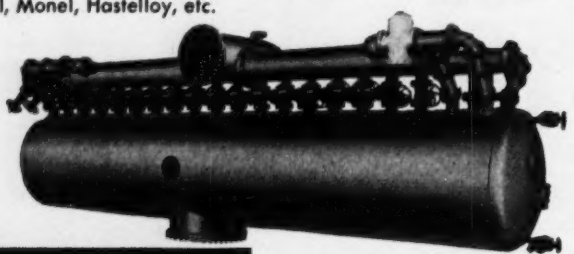
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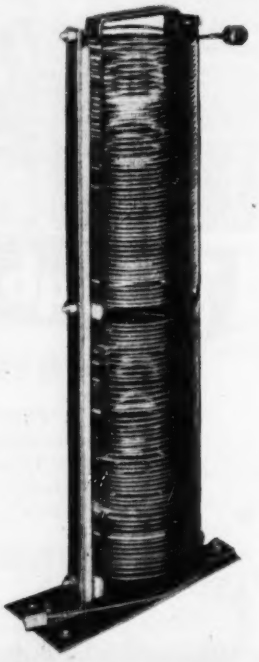
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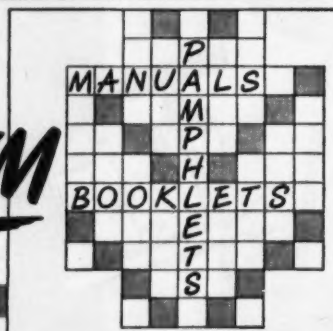
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13b	43a	80b	140-1	209e	255	280A	301	336	380	415	L443	476Q	480E	486C	
13c	43b	81	142A	209d	257	280B	302	337	381	TL416	M443a	477	480F	487A	
14	45	82	143	209e	259	280C	305	342	384	BL416	M443b	477A	480G	487B	
15	46	83	145	209f	261	280D	306a	343	L385	R416	M443c	477B	480H	488A	
16-7	47	84	146A	209g	262-3a	281	306b	346	BR385	417	R443	477C	481	488B	
20-1a	48	85	146B	209h	262-3b	282A	307	347	386	418	444	477D	481A	488C	
20-1b	49	86	146C	211	262-3c	282B	308	348	TL387	419	TL445	477E	481B	488D	
20-1c	50	87	147	213	262-3d	282C	309a	350	BL387	L420	BL445	477F	482A	48E	
20-1d	51	88	148A	215	262-3e	282D	309b	351	R387	TR420	R445	477W	482B	489A	
20-1e	52	89	148B	217	264A	282E	309c	352	388	BR420	446	477H	482C	489B	
20-1f	53	90	148C	219	265	282F	309d	353	TL389	421	448	4771	483	489C	
20-1g	54	91	148D	220-1	266A	282G	309e	354	BL389	L422	449	477J	483A	489D	
20-1h	55	92	149a	227	266B	283	309f	355	R389	TR422	TR451	477K	483B	489E	
20-1i	56	93	149b	228-9	266C	285a	310	356	390	BR422	467	477L	483C	491	
22-3a	57	94	149c	231	267	285b	311	357	TL391	423	468	477M	484A	493	
22-3b	58	95	149d	233a	268A	286	312	358	BL391	424	469	477N	484B	495a	
22-3c	59	96	149e	233b	269	287	313	359	R391	TL425	470	478	484C	495b	
22-3d	60	97	149f	233c	270A	288	314	360	392	BL425	471	478A	484D	495c	
22-3e	61	98	150A	233d	270B	289	315	361	TL393	TR426a	472	478B	484E	T496	
22-3f	62	99	150B	235	270C	290	316a	362	BL393	TR426b	473	478C	484F	B496	
22-3g	63	100	150C	236-7	271	291	316b	363a	R393	BR426	474	478D	484G	501	
24-5	64	102	150D	239a	272A	292a	317	363b	394	427	475	478E	484H	502a	
26	65	103	150E	239b	272B	292b	318a	363c	395	L428	476A	478F	484I	502b	
27	66a	107	150F	239c	272C	292c	318b	364	396	M428	476B	478G	484J	502c	
28-9	66b	148-9	150G	238d	272D	29 d	319	365	397	R428					

144A	150B	152C	154C	154G	270A	272C	274C	276D	278B	278F	280D	282B	282F	284C	
148A	150C	152D	154D	154H	270B	272D	276A	276E	278C	280A	280D	282C	284A	284D	
148B	152A	154A	154E	1541	272A	274A	276B	276F	278D	280B	280F	282B	284B	284E	
150A	152B	154B	154F	268A	272B	274B	276C	278A	278E	280C	282A	282E			

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Did You Miss Anything?

If you did, you'd better look again at this issue of Chemical Engineering. Maybe you missed a good bet. Did you see these articles:

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Save Time, Money, With Computers *Ascher Opler* **197**

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AND here is the Reader Service postcard that speeds more information to you.

Whenever you select a power unit, don't put a straight-jacket on your ideas . . . consider ALL of the possibilities of modern power drives.

For example consider the many useful combinations that can be secured with the basic Master power units shown below. They're designed so they can be easily combined together to give you the RIGHT horsepower, the RIGHT shaft speed, the RIGHT features in one compact unit that you can use RIGHT where you want it. Nowhere else will you find power units that are so flexible, so easily adaptable, and in such a wide range of types and ratings.

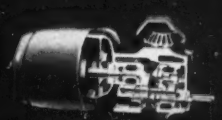
Master power drives are available in thousands and thousands of ratings (1/8 to 400 HP) . . . in open, enclosed, splash proof, fan cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 430 to 1 ratio . . . with electric brakes . . . with fluid drive . . . with mechanical or electronic variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best power drive for YOU.

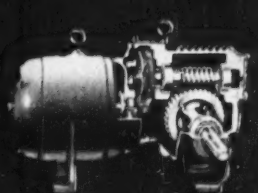
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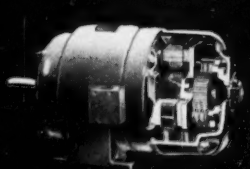
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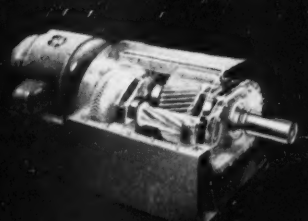








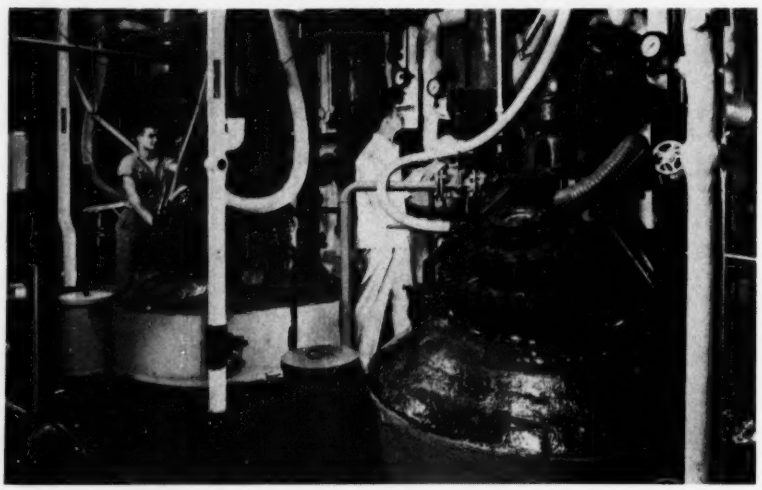
1/8 TO 400 HORSEPOWER



Corrosioneering News

Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

Published by The Pfaudler Co., Rochester, N.Y.



How DPi, Leading Vitamin E Producer Maintains Absolute Product Purity

Concentrating and purifying Vitamin E from natural vegetable oils is a delicate job. It's the "house specialty" of Distillation Products Industries, a division of Eastman Kodak Company.

By molecular distillation, DPi produces tocopherols in a number of forms. In every phase of their process—particularly the final step—extreme care must be taken to protect these products from contamination.

Critical Stage

The final stage in DPi's preparation of Vitamin E requires the protection of Pfaudler glassed steel reaction kettles. Fortified with an acid-alkali resistant inner surface, these reactors resist all forms of chemical attack, protecting the product from contamination.

Use of Pfaudler glassed steel equipment typifies the care that has made DPi a leader in the research and production of Vitamin E, as well as Vitamin A and distilled monoglycerides.

You too can profit by using Pfaudler glassed steel reactors. They are available in a complete range of capacities, from laboratory to full-scale production. When you make use of the custom features Pfaudler has incorporated in their standard design, you are able to get delivery on these reactors within two weeks.

How to Cool Off a Heat Exchanger Problem

With new processes on the horizon every day, Pfaudler engineers are receiving more and more requests for special features on heat exchangers.

To save you money on these designs, they have found that Pfaudler "flexible standard" stainless steel heat exchangers can be used as the base unit in a high percentage of cases.

For example, nozzles of any size—either flanged or threaded—can be installed in any position. And new production line methods make possible rapid deliveries—as few as 7 days!

To solve your problem, Pfaudler sales engineers can select from a complete line of heat exchangers—fixed tube sheet, single or multipass, tube and/or shell side stainless steel units. Shell diameters range from 4" to 24" in four basic types of construction: fixed tube sheet . . . outside packed floating head design . . . internal floating head . . . U-tube bundle. Most have removable tube bundles.

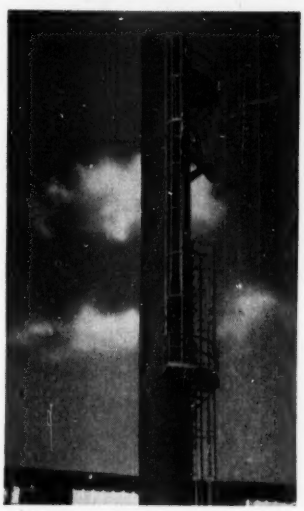
To take the heat off that heat transfer problem, discuss it with your Pfaudler representative. He has plenty of equipment to choose from.

Tall Story Lies Behind This Canadian Column

Two-thirds of this giant column was fabricated from stainless steel. The rest is carbon steel.

Seventy-seven feet high, the column projects into the sky above Canadian Chemical Company's plant at Edmonton, Alberta. It is a good example of the type of design and fabricating attention your problem will get when you turn it over to Pfaudler engineers.

In this case, a column was needed for a big, and very specific type of job. Seventy-seven feet high by 54 inches in diameter, it required custom fabrication.



Giant column has 40 sieve trays, is made of two types of steel.

Ordinarily, Pfaudler engineers are able to use economical standard units to solve problems of distillation, fractionation, stripping, bleaching and absorption. This saves you money, gives you the advantage of interchangeable components and uniformity of equipment designs.

To give you long-life equipment, Pfaudler offers a complete range of corrosion-resistant materials. This includes stainless steel, Hastelloy, monel, nickel, inconel, aluminum, glassed steel, and others.

Cut your equipment costs, and get the advantages of unbiased selection of construction materials, with Pfaudler glassed steel and alloy columns.